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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Work under separate contracts.
4. Contractor's use of site and premises.
5. Coordination with occupants.
6. Work restrictions.
7. Specification and Drawing conventions.
8. Sequence of Construction

1.2 PROJECT INFORMATION

A. Project Identification: Caesars Lane Wastewater Treatment Plant Expansion Phase 2

1. Project Location: 145 Caesars Lane, New Windsor, NY 12553

B. Owner: Town of New Windsor

555 Union Avenue, New Windsor, NY 12553

1. Owner's Representative: Stephen A. Bedetti, Town Supervisor

C. Engineer: MHE Engineering, D.P.C.

111 Wheatfield Drive, Suite 1, Milford, PA 18337

1. Engineer's Representative: Michael W. Weeks, P. E., Engineer for the Town

D. Consultants: Engineer or Owner has retained the following design professionals, who have prepared designated portions of the Contract Documents:

1. Mechanical Engineering: Jade Stone Engineering

2. Electrical Engineering: Jade Stone Engineering

3. Plumbing Engineering: Jade Stone Engineering

4. Hazardous Material Consultant: Quality Environmental Solutions & Technologies, Inc. (QuES&T)

5. Owner’s Special Inspector : Tectonic Engineering Consultants, Geologists & Land Surveyors, D.P.C.

E. Web-Based Project Software: Project software will be used for purposes of managing communication and documents during the construction stage.

1. See Section 013100 "Project Management and Coordination" and Section 013000 Administrative Requirements” for requirements for using web-based Project software.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. General Construction of new WWTP infrastructure including buildings, tanks, equipment, and various process structures, improvements and modifications to existing plant infrastructure, and complete or partial demolition of portions of existing plant infrastructure and other Work indicated in the Contract Documents.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.4 WORK UNDER SEPARATE CONTRACTS

A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under separate contracts.

B. Concurrent Work: Owner has awarded separate contract(s) for the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.

1. Caesars Lane WWTP Expansion Phase 1 Project to GC – General Construction, MC-Mechanical Construction, EC – Electrical Construction and PC-Plumbing Construction for Construction of a new plant control building, renovations to the existing plant control building, and associated site improvements at the Town of New Windsor Waste Water Treatment Plant. Work is expected to commence May 2025, with anticipated completion in September 2026.

1.5 CONTRACTOR'S USE OF SITE AND PREMISES

A. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

B. Limits on Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Driveways, Walkways, and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.

C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

D. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.6 COORDINATION WITH OCCUPANTS

A. Full Owner Occupancy: Owner will occupy site and existing building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.

1.7 WORK RESTRICTIONS

A. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work to normal business working hours of 7:00 a.m. to 5:00 p.m., Monday through Friday, unless otherwise indicated.

C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others.

D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.

E. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Project site is not permitted.

1.8 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.

C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

1.9 SEQUENCE OF CONSTRUCTION

A. Contractor shall develop a sequence of construction to allow for ongoing plant operation at all times. Sequence of construction shall be submitted to Engineer prior to the start of construction. Sequence of construction must be formally submitted as an action submittal for Engineer's review.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 013000 - ADMINISTRATIVE REQUIREMENTS

PART 1 – GENERAL

1.1 ELECTRONIC DOCUMENT PROCESSING SERVICE

A. To expedite the electronic review process, all prime contractors shall process all documents through a web-based software service.

B. Sending documents via email, FTP or paper will not be accepted.

C. The web-based software services shall be Newforma Project Cloud (web-based) (www.newformaprojectcloud.com, 800-303-4650) or approved equal.

D. Minimum Performance Requirements

1. Project License

a) Cloud based (no hardware required)
b) Unlimited user accounts
c) Functionality to support other prime contractors, subcontractors, engineer, project consultants, and Owner
d) Provide access to data for all project team members at no cost to the individual users

2. Training and Support

a) Dedicated project training and phone support at no cost to the individual users.

3. Archive

a) Export all data to an offline archive at the completion of the project
b) Provide archive to engineer, contractor and owner or fixed storage device.
c) Archive shall include all attachments, meta data, review comments and time stamp history.

4. Submittals and RFIs

a) Customizable logs and reporting accessible by all users
b) Logs shall automatically update as submittals and RFIs are processed
c) Automated routing of submittals and RFIs to design team based on trade
d) Automated email notifications when submittal or RFI has been assigned or returned to a user
e) Automated weekly email to design team users of overdue items
f) Automatic sequential numbering per spec section for submittals

g) Two sets of due dates – one overall due date and a consultant due date
h) Built-in web-based markup tools to support a concurrent review of submittal and RFI
i) Hard copies may be requested by the Engineer.

5. Submittal register

   a) Prime Contractor shall take specifications and build the required list of submittals and import into the software

6. Drawing Management

   a) Provide current set of drawings and specifications through a centralized index
   b) Automated association of PDFs to the centralized index
   c) Manage drawing revisions with customizable review states
   d) Drawings shall be accessible offline via mobile devices

7. File Sharing

   a) Integrated file sharing tool (FTP) to transfer any miscellaneous files
   b) Access permissions (view/edit) at a folder level

8. Punch List and other field task management

   a) Unlimited customizable field task types including punch list
   b) Locate and assign tasks from a mobile device
   c) No additional fees to individual users to access mobile apps
   d) Data shall be accessible offline on mobile devices

END OF SECTION 013000

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. RFIs.
4. Project Meetings

B. Related Requirements:

1. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.

1.2 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

1.3 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

1.4 COORDINATION DRAWINGS

A. Coordination Drawings, General: Contractor shall prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

    a. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    b. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Engineer indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

1.5 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Engineer will return without response those RFIs submitted to Engineer by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Owner name.
2. Owner's Project number.
3. Name of Engineer.
4. Engineer's Project number.
5. Date.
6. Name of Contractor.

7. RFI number, numbered sequentially.
8. RFI subject.
9. Specification Section number and title and related paragraphs, as appropriate.
10. Drawing number and detail references, as appropriate.
11. Field dimensions and conditions, as appropriate.
12. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
13. Contractor's signature.
14. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

C. Engineer's Action: Engineer will review each RFI, determine action required, and respond. Allow seven days for Engineer's response for each RFI. RFIs received by Engineer after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for approval of Contractor's means and methods.
    d. Requests for coordination information already indicated in the Contract Documents.
    e. Requests for adjustments in the Contract Time or the Contract Sum.
    f. Requests for interpretation of Engineer's actions on submittals.
    g. Incomplete RFIs or inaccurately prepared RFIs.

2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt by Engineer of additional information.
3. Engineer's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."

    a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Engineer in writing within five days of receipt of the RFI response.

D. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Log shall be updated continuously in project management software. Software log with not less than the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Engineer.
4. RFI number including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Engineer's response was received.

E. On receipt of Engineer's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Engineer within seven days if Contractor disagrees with response.

1.6 PROJECT MEETINGS

A. General: Engineer will schedule and conduct meetings and conferences at Project site unless otherwise indicated.

B. Preconstruction Conference: Engineer will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Engineer, but no later than 15 days after execution of the Agreement.

1. Attendees: Authorized representatives of Owner Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:

    a. Responsibilities and personnel assignments.
    b. Tentative construction schedule.
    c. Phasing.
    d. Critical work sequencing and long lead items.
    e. Designation of key personnel and their duties.
    f. Lines of communications.
    g. Procedures for processing field decisions and Change Orders.
    h. Procedures for RFIs.
    i. Procedures for testing and inspecting.
    j. Procedures for processing Applications for Payment.
    k. Distribution of the Contract Documents.
    l. Submittal procedures.
    m. Preparation of Record Documents.
    n. Use of the premises and existing building.
    o. Work restrictions.
    p. Working hours.
    q. Owner's occupancy requirements.
    r. Responsibility for temporary facilities and controls.
    s. Procedures for moisture and mold control.
    t. Procedures for disruptions and shutdowns.
    u. Construction waste management and recycling.
    v. Parking availability.
    w. Office, work, and storage areas.
    x. Equipment deliveries and priorities.
    y. First aid.
    z. Security.
    aa. Progress cleaning.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other sections and when required for coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Engineer of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

    a. Contract Documents.
    b. Options.
    c. Related RFIs.
    d. Related Change Orders.
    e. Purchases.
    f. Deliveries.
    g. Submittals.
    h. Sustainable design requirements.
    i. Review of mockups.
    j. Possible conflicts.
    k. Compatibility requirements.
    l. Time schedules.
    m. Weather limitations.
    n. Manufacturer's written instructions.
    o. Warranty requirements.
    p. Compatibility of materials.
    q. Acceptability of substrates.
    r. Temporary facilities and controls.
    s. Space and access limitations.
    t. Regulations of authorities having jurisdiction.
    u. Testing and inspecting requirements.
    v. Installation procedures.
    w. Coordination with other work.
    x. Required performance results.
    y. Protection of adjacent work.
    z. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Progress Meetings: Conduct progress meetings at biweekly intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner and Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in

planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

    a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

        1) Review schedule for next period.

    b. Review present and future needs of each entity present, including the following:

        1) Interface requirements.
        2) Sequence of operations.
        3) Resolution of BIM component conflicts.
        4) Status of submittals.
        5) Deliveries.
        6) Off-site fabrication.
        7) Access.
        8) Site use.
        9) Temporary facilities and controls.
        10) Progress cleaning.
        11) Quality and work standards.
        12) Status of correction of deficient items.
        13) Field observations.
        14) Status of RFIs.
        15) Status of Proposal Requests.
        16) Pending changes.
        17) Status of Change Orders.
        18) Pending claims and disputes.
        19) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

    a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Preconstruction photographs.
2. Concealed Work photographs.
3. Periodic construction photographs.
4. Final completion construction photographs.

B. Related Requirements:

1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
2. Section 024116 "Structure Demolition" for photographic documentation before building demolition operations commence.
3. Section 024119 "Selective Demolition" for photographic documentation before selective demolition operations commence.
4. Section 311000 "Site Clearing" for photographic documentation before site clearing operations commence.

1.2 INFORMATIONAL SUBMITTALS

A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.

B. Digital Photographs: Submit image files within 7 days of taking photographs.

1. Submit photos by uploading to web-based Project management software site. Include copy of key plan indicating each photograph's location and direction.
2. Identification: Provide the following information with each image description in file metadata tag in web-based Project management software site, as applicable:

a. Name of Project.
b. Name and contact information for photographer.
c. Name of Engineer.
d. Name of Contractor.
e. Date photograph was taken.
f. Description of location, vantage point, and direction.
g. Unique sequential identifier keyed to accompanying key plan.

C. Printed Photographs: Submit two sets of prints of each photographic view within seven days of taking photographs.

1. Format: 8-by-10-inch smooth-surface matte prints on single-weight, paper; enclosed back to back in clear plastic sleeves punched for three-ring binder. Include copy of key plan indicating each photograph's location and direction. Provide one binder for each set of prints.
2. Identification: On back of each print, label with the following information:

    a. Name of Project.
    b. Name and contact information for photographer.
    c. Name of Engineer.
    d. Name of Contractor.
    e. Date photograph was taken if not date stamped by camera.
    f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
    g. Unique sequential identifier keyed to accompanying key plan.

1.3 QUALITY ASSURANCE

A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.

1.4 FORMATS AND MEDIA

A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels, and with vibration-reduction technology. Use flash in low light levels or backlit conditions.

B. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

C. Metadata: Record accurate date and time and GPS location data from camera.

D. File Names: Name media files with date and Project area and sequential numbering suffix.

1.5 CONSTRUCTION PHOTOGRAPHS

A. Photographer: Engage a qualified photographer to take construction photographs.

B. General: Take photographs with maximum depth of field and in focus.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

C. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Engineer.

1. Flag construction limits before taking construction photographs.

2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
3. Take 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

D. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work, including, but not limited to, the following:

1. Underground utilities.
2. Underslab services.
3. Piping.
4. Electrical conduit.
5. Waterproofing and weather-resistant barriers.
6. Work to be located within walls or other locations to be covered by finish materials.

E. Periodic Construction Photographs: Take 50 photographs weekly coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

F. Final Completion Construction Photographs: Take 100 photographs after date of Substantial Completion for submission as Project Record Documents. Engineer will inform photographer of desired vantage points.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013233

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submittal schedule requirements.
2. Administrative and procedural requirements for submittals.

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Engineer’s responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL SCHEDULE AND SEQUENCE OF CONSTRUCTION

A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review (minimum two weeks), ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and additional time for handling and reviewing submittals required by those corrections.

B. Sequence of Construction: Contractor shall develop a sequence of construction to allow for ongoing plant operation at all times. Sequence of construction shall be submitted to Engineer prior to the start of construction. Sequence of construction must be formally submitted as an action submittal for Engineer’s review.

1.4 SUBMITTAL FORMATS

A. Submittal Information: Include the following information in each submittal:

1. Project name.
2. Date.
3. Name of Engineer.
4. Name of Contractor.
5. Name of firm or entity that prepared submittal.
6. Names of subcontractor, manufacturer, and supplier.

7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier; and alphanumeric suffix for resubmittals.
8. Category and type of submittal.
9. Submittal purpose and description.
10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
11. Drawing number and detail references, as appropriate.
12. Indication of full or partial submittal.
13. Location(s) where product is to be installed, as appropriate.
14. Other necessary identification.
15. Remarks.
16. Signature of transmitter.

B. Options: Identify options requiring selection by Engineer.

C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Engineer on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

D. Submittals for Utilizing Web-Based Project Management Software: Prepare submittals as PDF files, or other format indicated by Project management software.

1.5 SUBMITTAL PROCEDURES

A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 10 business days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
2. Resubmittal Review: Allow 10 days for review of each resubmittal.

D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.

1.6 SUBMITTAL REQUIREMENTS

A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

    a. Manufacturer's catalog cuts.
    b. Manufacturer's product specifications.
    c. Standard color charts.
    d. Statement of compliance with specified referenced standards.
    e. Testing by recognized testing agency.
    f. Application of testing agency labels and seals.
    g. Notation of coordination requirements.
    h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

    a. Wiring diagrams that show factory-installed wiring.
    b. Printed performance curves.
    c. Operational range diagrams.
    d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before Shop Drawings, and before or concurrent with Samples.

B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Engineer's digital data drawing files is otherwise permitted.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

    a. Identification of products.
    b. Schedules.
    c. Compliance with specified standards.
    d. Notation of coordination requirements.
    e. Notation of dimensions established by field measurement.

f. Relationship and attachment to adjoining construction clearly indicated.
g. Seal and signature of professional engineer if specified.

2. Paper Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.

C. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other materials.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Permanently attach label on unexposed side of Samples that includes the following:

a. Project name and submittal number.
b. Generic description of Sample.
c. Product name and name of manufacturer.
d. Sample source.
e. Number and title of applicable Specification Section.
f. Specification paragraph number and generic name of each item.

3. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Engineer will return submittal with options selected.

6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

a. Number of Samples: Submit three sets of Samples. Engineer will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record Sample.

1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of Engineers and owners, and other information specified.

F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.

G. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

H. Test and Research Reports:

1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate preparation and primers required.

2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

    a. Name of evaluation organization.
    b. Date of evaluation.
    c. Time period when report is in effect.
    d. Product and manufacturers' names.
    e. Description of product.
    f. Test procedures and results.
    g. Limitations of use.

1.7 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Engineer.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.8 CONTRACTOR'S REVIEW

A. Action Submittals and Informational Submittals: Contractor shall review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract

Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.

B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp or indication in web-based Project management software. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Engineer will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ENGINEER'S REVIEW

A. Action Submittals: Engineer will review each submittal, indicate corrections or revisions required, and return it.

1. Submittals by Web-Based Project Management Software: Engineer will indicate, on Project management software website, the appropriate action.

B. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Engineer will forward each submittal to appropriate party.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Engineer will return without review or discard submittals received from sources other than Contractor.

F. Submittals not required by the Contract Documents will be returned by Engineer without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
2. Requirements for Contractor to provide quality-assurance and quality-control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.2 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.

1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

D. Mockups: Full-size physical assemblies that are constructed on-site either as freestanding temporary built elements or as part of permanent construction. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. Laboratory Mockups: Full-size physical assemblies constructed and tested at testing facility to verify performance characteristics.

2. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as freestanding temporary built elements or as indicated in-place portions of permanent construction if approved by Engineer, consisting of multiple products, assemblies, and subassemblies, with cutaways enabling inspection of concealed portions of the Work.

    a. Include each system, assembly, component, and part of the exterior wall and roof to be constructed for the Project. Colors of components shall be those selected by the Engineer for use in the Project.

3. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes; doors; windows; millwork; casework; specialties; furnishings and equipment; and lighting.
4. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
5. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.

E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall have the same meaning as testing agency.

I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Engineer.

1.3 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.

B. Delegated-Design Services Statement: Submit a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.4 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Engineer regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Engineer for clarification before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

1.5 ACTION SUBMITTALS

A. Mockup Shop Drawings: For integrated exterior mockups.

1. Include plans, sections, elevations, and details, indicating materials and size of mockup construction.
2. Indicate manufacturer and model number of individual components.
3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.6 INFORMATIONAL SUBMITTALS

A. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
2. Main wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.

B. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

C. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.7 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, telephone number, and email address of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Statement on condition of substrates and their acceptability for installation of product.
2. Statement that products at Project site comply with requirements.
3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
5. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Statement that equipment complies with requirements.
2. Results of operational and other tests and a statement of whether observed performance complies with requirements.
3. Other required items indicated in individual Specification Sections.

1.8 QUALITY ASSURANCE

A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to ASTM E329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:

a. Provide test specimens representative of proposed products and construction.

b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
c. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
d. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Engineer and Owner, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed by Engineer.
3. Notify Engineer seven days in advance of dates and times when mockups will be constructed.
4. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed to perform same tasks during the construction at Project.
5. Demonstrate the proposed range of aesthetic effects and workmanship.
6. Obtain Engineer's approval of mockups before starting corresponding work, fabrication, or construction.

a. Allow seven days for initial review and each re-review of each mockup.

7. Promptly correct unsatisfactory conditions noted by Engineer's preliminary review, to the satisfaction of the Engineer, before completion of final mockup.
8. Approval of mockups by the Engineer does not constitute approval of deviations from the Contract Documents contained in mockups unless Engineer specifically approves such deviations in writing.
9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
10. Demolish and remove mockups when directed unless otherwise indicated.

K. Integrated Exterior Mockups: Construct integrated exterior mockup according to approved Shop Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials. Comply with requirements in "Mockups" Paragraph.

1. Coordinate construction of the mockup to allow observation of air barrier installation, flashings, air barrier integration with fenestration systems, and other portions of the building air/moisture barrier and drainage assemblies, prior to installation of veneer, cladding elements, and other components that will obscure the work.

L. Room Mockups: Construct room mockups according to approved Shop Drawings, incorporating required materials and assemblies, finished according to requirements. Provide required lighting and additional lighting where required to enable Engineer to evaluate quality of the Work. Comply with requirements in "Mockups" Paragraph.

1. Provide room mockups in locations indicated on the drawings.

1.9 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.

1. Engage a qualified testing agency to perform quality-control services.

    a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
4. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

D. Testing Agency Responsibilities: Cooperate with Engineer, Owner and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Engineer, Owner, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected Work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform duties of Contractor.

E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
6. Security and protection for samples and for testing and inspection equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.10 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency or special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in the Statement of Special Inspections attached to this Section or as provided elsewhere in the contract documents, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Engineer, Owner, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Engineer and Owner with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.

6. Retesting and reinspecting corrected Work.
7. Costs associated with failure to properly schedule the inspections or for retesting and reinspection shall be borne by the Contractor.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Engineer.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Engineer's and Owners authorities' having jurisdiction reference during normal working hours.

1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014535 – CODE-REQUIRED SPECIAL INSPECTIONS AND PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for special inspections and procedures required by the 2020 Building Code of New York State (2020 BCNYS), National Electrical Code, and local Town codes.

B. A Special Inspections preconstruction meeting should be held at least 7 days prior to the initial planned date for start of construction.
   1. Discussion shall include review of specifications and Schedule of Special Inspections for work requiring Special Inspections; responsibilities of Contractor, Owner, Testing Agency, Special Inspector, and Engineer; notification procedures; and reporting procedures.
   2. Attendees shall include the Contractor, Owner's Representative, Testing Agency, Special Inspector, and Engineers for Structural Engineering and for Architecture.

C. Special Inspector shall not engage for services of other inspections required by the Contractor on this project.

1.3 RELATED SECTIONS

A. Related Sections include the following:
   1. Divisions 2 through 46 Sections for non-building code related test and inspection requirements.

1.4 DEFINITIONS

A. Engineer or Design Engineer: The licensed Professional Engineer or Registered Architect whose seal appears on the Construction Drawings. Unless noted otherwise, references to the Engineer in this section refer to the appropriate Engineer for the design as defined in Division 1 "Summary".

B. Code Enforcement Official: The Officer or other designated authority charged with administration and enforcement of the 2020 BCNYS.

C. Testing/Inspecting Agency: An agent retained by the Special Inspector or by the Owner and coordinated by the Special Inspector, to perform some of the inspection services on behalf of the Special Inspector. A Geotechnical Engineer is an example of an Inspecting Agency.

D. Special Inspection: Inspection required by code of materials, installation, fabrication, erection, or placement of components and connections requiring special expertise to ensure compliance with approved Contract Plans, details, and the standards referenced above.

E. Special Inspector: A qualified person employed or retained by an approved agency and approved by the building official as having the competence necessary to inspect a particular type of construction requiring special inspection.

F. Special Inspection Coordinator: Is responsible for managing, updating, and maintaining the inspection database. They are also responsible for coordinating the scheduling of inspections and are responsible for completing all associated inspections and electronic paperwork.

G. Statement of Special Inspections: A document prepared by the Engineer and filed with and approved by the Code Enforcement Official that includes the Schedule of Special Inspections listing the materials and work requiring Special Inspections. This document includes the inspections and verifications required for the project.

H. Continuous Special Inspection: The full-time observation of work requiring Special Inspections by the Special Inspector who is present in the area where the work is being performed.

I. Periodic Special Inspections: The part-time or intermittent observation of work requiring Special Inspections by the Special Inspector who is present in the area where the work has been or is being performed and at the completion of the work.

1.5 QUALIFICATIONS

A. The Special Inspector shall be a Professional Engineer licensed in the State of New York who is accepted by the Design Engineer and by the Code Enforcement Official.

B. The Testing/Inspecting Agency shall be accepted by the design engineer and by the Town's Code Enforcement Officer.

C. Special Inspections shall be performed by inspectors who are either Professional Engineers (P.E.) or Engineers-In-Training (EIT) certified in the State that matches the project location and with an education and background in structural engineering, except as indicated below:

1. Special Inspections of soils and foundations may be performed by inspectors who are either Professional Engineers (P.E.) or Engineers-In-Training (EIT) with an education and background in geotechnical engineering.
2. Technicians performing tests of concrete shall be ACI Certified Concrete Field Technicians - Grade 1 or higher.
3. Inspectors performing inspections of concrete work may be ACI Certified Concrete Construction Inspectors or other qualified individuals with experience inspecting concrete work, designated and supervised by the Special Inspector.
4. Inspectors performing inspections of other work such as masonry, wood framing, and steel framing may be qualified individuals with experience inspecting such work, designated and supervised by the Special Inspector.
5. Technicians performing tests or inspections of welds shall be AWS Certified Welding Inspectors. Technicians performing ultrasonic testing shall also be certified as an ASNTTC Level II or Level III technician.

6. Technicians performing standard tests described by specific ASTM standards shall have training in the performance of such tests and must be able to demonstrate either by oral or written examination competence for the test to be performed. They shall not be permitted to independently evaluate test results.
7. Technicians of Testing/Inspecting Agencies for smoke control shall have expertise in fire-protection engineering and mechanical engineering and shall have certification as air balancers.

1.6 SUBMITTALS

A. The Special Inspector and Testing/Inspecting Agency shall submit to the Design Engineer and Code Enforcement Official a copy of their qualifications for review, including the names and qualifications of each of the individual inspectors and technicians who will be performing inspections or tests.

B. The Special Inspector and Testing/Inspecting Agency shall disclose past or present business relationship or potential conflict of interest with the Contractor or Subcontractors whose work will be inspected or tested.

1.7 PAYMENT

A. Special inspections shall be an independent third party engaged by Owner to perform said inspections and is paid by Owner.

B. Contractor shall be responsible for the cost of re-testing and/or re-inspecting of work failing to comply with the requirements of the Contract Documents or above referenced standards.

1.8 OWNER RESPONSIBILITIES

A. The Owner will provide the Special Inspector(s) with a complete set of Contract Documents sealed by the Engineer and approved by the Code Enforcement Official as applicable.

B. Owner shall engage the services of special inspectors and shall ensure inspectors are ready to perform when Contractors need them to.

1.9 CONTRACTOR RESPONSIBILITIES

A. Contractor shall coordinate with special inspectors to ensure inspections are performed in a timely manner with little or no delay and without hindrance.

B. Delays resulting from inadequate coordination shall not be justification for contract time extensions. Failure of the inspector to be able to perform inspections when Contractor is prepared for them is a justifiable cause for contract time extensions.

C. Contractor shall notify the Special Inspector or Testing/Inspecting Agency at least 48 hours in advance of a required inspection or test.

D. Contractor shall provide incidental labor and facilities to provide access to the work to be inspected or tested, to obtain and handle samples at the site or at source of products to be tested, to facilitate tests and inspections, and for storage and curing of test samples.

E. If Special Inspections or testing require the use of Contractor's scaffolding to access work areas, Contractor shall provide a competent person to perform a daily evaluation of the scaffolding to verify that it is safe to use. The contractor shall notify the Special Inspector and Testing Agent of this review before each use. The contractor is responsible for the safe assembly and stability of the scaffolding.

F. All work requiring special inspection shall remain accessible and exposed until it has been observed by the Special Inspector.

G. The contractor shall keep the latest set of Construction Drawings, field sketches, accepted shop drawings, and specifications at the project site for field use by the Inspectors and Testing Technicians.

H. The Special Inspection program shall not relieve Contractor of his obligation to perform work in accordance with the requirements of the Contract Documents or from implementing an effective Quality Control program.

I. The contractor shall be solely responsible for construction site safety.

J. If applicable to the project, each Contractor responsible for the construction of a seismic-force-resisting system listed in the Quality Assurance Plan for Seismic Resistance and indicated in the drawings shall submit a written Contractor's Statement of Responsibility to the Code Enforcement Official, Special Inspector, Engineer, and Owner prior to the commencement of work on the system or component. The Contractor's Statement of Responsibility shall contain the following:

1. Acknowledgment of awareness of the special requirements contained in the Quality Assurance Plan.
2. Acknowledgment that control will be exercised to obtain conformance with the Construction Documents approved by the Code Enforcement Official.
3. Procedures for exercising control within the Contractor's organization, the method and frequency of reporting, and the distribution of the reports.
4. Identification and qualifications of each person exercising such control and his position in the organization.

1.10 DUTIES OF THE SPECIAL INSPECTOR

A. The Special Inspector shall review all work listed below for conformance with the approved construction plans and specifications for the 2020 BCNYS.

B. The Special Inspector shall furnish special inspection reports to the EOR, Contractor, Owner, and Building Official on a weekly basis, or more frequently as required by the Building Official. All items not in compliance shall be brought to the immediate attention of the Contractor for correction, and if uncorrected, to the EOR and Building Official.

C. Once corrections have been made by the Contractor, the Special Inspector shall submit a final signed report to the Building Official and EOR stating that the work requiring special inspection

was, to the best of the Special Inspector's knowledge, in conformance with the approved construction plans and specifications as well as the applicable workmanship provisions of the 2020 BCNYS.

1.11 LIMITS ON AUTHORITY

A. The Special Inspector or Testing/Inspecting Agency shall not release, revoke, alter, or enlarge on the requirements of the Contract Documents.

B. The Special Inspector or Testing/Inspecting Agency shall not have control over the Contractor's means and methods of construction.

C. The Special Inspector or Testing/Inspecting Agency shall not be responsible for construction site safety.

D. The Special Inspector or Testing/Inspecting Agency shall not have the authority to stop the work.

1.12 STATEMENT OF SPECIAL INSPECTIONS

A. The Statement of Special Inspections and the Schedule of Special Inspections have been prepared by the Engineer.

B. The Special Inspector shall provide or coordinate inspection and testing requirements as necessary in accordance with the provisions of the 2020 BCNYS, these specifications, the Statement of Special Inspections, and the Quality Assurance Plan for Seismic Resistance.

C. Required inspections and tests are described in the Schedule of Special Inspections included in the drawings and in the attached individual specification sections for the items to be inspected or tested.

D. The Statement of Special Inspections and, if applicable, the Quality Assurance Plan for Seismic Resistance shall be submitted with the Application for Building Permit.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Detailed reports shall be prepared of each test or inspection. Reports shall include:
   1. Date of test or inspection.
   2. Name of Testing Agency or Inspecting Agency.
   3. Name of technician or inspector.
   4. Locations of specific areas tested or inspected.
   5. Description of test or inspection and results.
   6. Reference to applicable ASTM standard.

7. Weather conditions.

B. The Testing/Inspecting Agency shall immediately notify the Contractor, Special Inspector, and Engineer by telephone or fax of test results failing to comply with the requirements of the Contract Documents.

C. The Special Inspector shall immediately notify the Contractor of discrepancies from the Contract Documents found during a Special Inspection. If discrepancies are not corrected before the Special Inspector leaves the site, the Special Inspector shall notify the Engineer within 24 hours (one business day) and issue a non-conformance report. If discrepancies are not corrected by the time of substantial completion or other appropriate time, the Special Inspector shall notify the Code Enforcement Official.

D. The Testing/Inspecting Agency shall submit reports to the Special Inspector and the Engineer within 7 days of the inspection or test. Legible handwritten reports may be submitted if final typed copies are not available.

E. At the completion of work requiring Special Inspections, each Testing/Inspecting Agency shall provide an Agent's Final Report of Special Inspections to the Special Inspector stating that work was completed in substantial conformance with the Contract Documents and that appropriate inspections and tests were performed.

F. The Special Inspector shall submit reports to the Engineer within 7 days of the inspections. Legible handwritten reports may be submitted if final typed copies are not available. In addition, the Special Inspector shall submit interim reports at intervals noted in the Statement of Special Inspection, including reports for inspections and tests performed since the previous interim report or since the beginning of construction for the first interim report.

G. Interim reports shall be addressed to the Code Enforcement Official with copies sent to the Engineers (Structural Engineer and Architect) and Contractor.

H. Interim reports shall be signed and stamped by a Professional Engineer.

3.2 FINAL REPORT OF SPECIAL INSPECTIONS

A. The Final Report of Special Inspections shall be completed by the Special Inspector and submitted to the Engineer and Code Enforcement Official prior to issuance of a Certificate of Use and Occupancy.

B. CASE Form 102-2001 or other similar form shall be used for the Final Report of Special Inspections.

END OF SECTION 014535

Statement of Special Inspections

Project: *Town of New Windsor Caesars Lane Wastewater Treatment Plant Expansion Phase 2*

Location: *145 Caesars Lane, New Windsor, New York 12553*

Owner: *Town of New Windsor*

Design Professional in Responsible Charge: *MHE Engineering, D.P.C.*

This *Statement of Special Inspections* is submitted as a condition for permit issuance in accordance with the Special Inspection and Structural Testing requirements of the Building Code. It includes a schedule of Special Inspection services applicable to this project. This *Statement of Special Inspections* encompass the following disciplines:

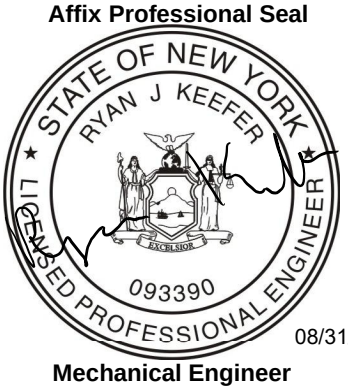
X Structural	Mechanical/Electrical/Plumbing
X Architectural	Other: _____

Discovered discrepancies shall be brought to the immediate attention of the Contractor for correction. If such discrepancies are not corrected, the discrepancies shall be brought to the attention of the Building Official and the Registered Design Professional in Responsible Charge. The Special Inspection program does not relieve the Contractor of his or her responsibilities.

A *Final Report of Special Inspections* documenting completion of all required Special Inspections, testing and correction of any discrepancies noted in the inspections shall be submitted prior to issuance of a Certificate of Use and Occupancy.

Job site safety and means and methods of construction are solely the responsibility of the Contractor.

As the Registered Design Professional(s) in Responsible Charge for this project, I/we certify this Statement of Special Inspections includes a complete list of materials and work that require special inspection and testing, and the minimum qualifications of the Special Inspectors / testing agencies required to be considered for conducting the inspections and testing. This represents the complete extent of special inspections and testing required during the construction of this project and complies with the 2020 New York State Uniform Fire Prevention and Building Code.

Affix Professional Seal	**Affix Professional Seal**	**Affix Professional Seal**
		
02/29/2028	10/31/2025	08/31/2025
Structural Engineer	**Architect**	**Mechanical Engineer**
Joseph Sinsabaugh 04/18/2025	Andrew Warren 04/18/2025	Ryan Keefer 04/18/2025
Print name/date	**Print name/date**	**Print name/date**
(Signature)	**(Signature)**	**(Signature)**

SCHEDULE OF SPECIAL INSPECTIONS

Reference Specification 01 45 35 for all requirements not noted as part of this schedule.

INSPECTION DEFINITIONS:

PERFORM: Perform these tasks for each weld, fastener or bolted connection, and noted verification.

OBSERVE: Observe these items randomly during the course of each work day to insure that applicable requirements are being met. Operations need not be delayed pending these inspections at contractor's risk.

DOCUMENT: Document, with a report, that the work has been performed in accordance with the contract documents. This is in addition to any other reports required in the Special Inspections guide specification.

CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

The Seismic Design Category for this project is: ☐ A, ☒ B, ☐ C, ☐ D, ☐ E, ☐ F (check appropriate box)

STRUCTURAL - STEEL – WELDING SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

STEEL INSPECTION PRIOR TO WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.4-1		
TASK	INSPECTION TYPE[1]	DESCRIPTION
1. Verify that the welding procedures specification (WPS) is available	**PERFORM**	
2. Verify manufacturer certifications for welding consumables are available	**PERFORM**	
3. Verify material identification	**PERFORM**	Type and grade.
4. Welder Identification System	**PERFORM**	The fabricator or erector, as applicable, shall maintain a system by which a welder who has welded a joint or member can be identified. Stamps, if used, shall be the low-stress type.
5. Fit-up of groove welds (including joint geometry)	OBSERVE	✓ Joint preparation ✓ Dimensions (alignment, root opening, root face, bevel) ✓ Cleanliness (condition of steel surfaces) ✓ Tacking (tack weld quality and location) ✓ Backing type and fit (if applicable)
6. Configuration and finish of access holes	OBSERVE	
7. Fit-up of fillet welds	OBSERVE	✓ Dimensions (alignment, gaps at root) ✓ Cleanliness (condition of steel surfaces) ✓ Tacking (tack weld quality and location)
STEEL INSPECTION DURING WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.4-2		
TASK	INSPECTION TYPE	DESCRIPTION
8. Use of qualified welders	**PERFORM**	Welding by welders, welding operators, and tack welders who are qualified in conformance with requirements.
9. Control and handling of welding consumables	OBSERVE	✓ Packaging ✓ Electrode atmospheric exposure control
10. No welding over cracked tack welds	OBSERVE	
11. Environmental conditions	OBSERVE	✓ Wind speed within limits ✓ Precipitation and temperature
12. Welding Procedures Specification followed	OBSERVE	✓ Settings on welding equipment ✓ Travel speed ✓ Selected welding materials ✓ Shielding gas type/flow rate ✓ Preheat applied ✓ Interpass temperature maintained (min./max.) ✓ Proper position (F, V, H, OH) ✓ Intermix of filler metals avoided
13. Welding techniques	OBSERVE	✓ Interpass and final cleaning ✓ Each pass within profile limitations ✓ Each pass meets quality requirements

[1] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

STRUCTURAL - STEEL – WELDING SECTION (CONTINUED)

STEEL INSPECTION AFTER WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.4-3		
TASK	INSPECTION TYPE [1]	DESCRIPTION
14. Welds cleaned	OBSERVE	
15. Size, length, and location of all welds	**PERFORM**	Size, length, and location of all welds conform to the requirements of the detail drawings.
16. Welds meet visual acceptance criteria	**PERFORM AND DOCUMENT**	✓ Crack prohibition ✓ Weld/base-metal fusion ✓ Crater cross section ✓ Weld profiles ✓ Weld size ✓ Undercut ✓ Porosity
17. Arc strikes	**PERFORM**	
18. k-area	**PERFORM**	When welding of doubler plates, continuity plates or stiffeners has been performed in the k-area, visually inspect the web k-area for cracks.
19. Backing removed, weld tabs removed and finished, and fillet welds added where required	**PERFORM**	
20. Repair activities	**PERFORM AND DOCUMENT**	
21. Document acceptance or rejection of welded joint or member	**PERFORM**	

END SECTION

[1] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - STEEL – BOLTING SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

STEEL INSPECTION TASKS PRIOR TO BOLTING – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.6-1		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Manufacture's certifications available for fastener materials	**PERFORM**	
2. Fasteners marked in accordance with ASTM requirements	OBSERVE	
3. Proper fasteners selected for joint detail (grade, type, bolt length if threads are to be excluded from shear plane)	OBSERVE	
4. Proper bolting procedure selected for joint detail	OBSERVE	
5. Connecting elements, including appropriate faying surface condition and hole preparation, if specified, meet applicable requirements	OBSERVE	
6. Proper storage provided for bolts, nuts, washers, and other fastener components	OBSERVE	
STEEL INSPECTION TASKS DURING BOLTING – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.6-2		
TASK	INSPECTION TYPE [1]	DESCRIPTION
7. Fastener assemblies of suitable condition, placed in all holes and washers (if required) are positioned as required	OBSERVE	
8. Joint brought to the snug-tight condition prior to pretensioning operation	OBSERVE	
9. Fastener component not turned by the wrench prevented from rotating	OBSERVE	
10. Bolts are pretensioned in accordance with RCSC Specification, progressing systematically from the most rigid point toward the free edges	OBSERVE	
STEEL INSPECTION TASKS AFTER BOLTING – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.2.1, AISC 360-10: Table C-N5.6-3		
TASK	INSPECTION TYPE [1]	DESCRIPTION
11. Document acceptance or rejection of all bolted connections	**DOCUMENT**	

END SECTION

[1] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - STEEL - NON DESTRUCTIVE TESTING SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

NONDESTRUCTIVE TESTING OF WELDED JOINTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Section N5.5		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Use of qualified nondestructive testing personnel	**PERFORM**	Visual weld inspection and nondestructive testing (NDT) shall be conducted by personnel qualified in accordance with AWS D1.8 clause 7.2
2. CJP groove welds	OBSERVE	Dye penetrant testing (DT) and ultrasonic testing (UT) shall be performed on 20% of CJP groove welds for materials greater than 5/16" (8mm) thick. Testing rate must be increased to 100% if greater than 5% of welds tested have unacceptable defects.
3. Welded joints subject to fatigue	OBSERVE	Dye penetrant testing (DT) and Ultrasonic testing (UT) shall be performed on 100% of welded joints identified on contract drawings as being subject to fatigue.
4. Weld tab removal sites	OBSERVE	At the end of welds where weld tabs have been removed, magnetic particle testing shall be performed on the same beam-to-column joints receiving UT

END SECTION

[1] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

STRUCTURAL - STEEL – AISC 341 REQUIREMENTS (SEISMIC PROVISIONS) SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

NONDESTRUCTIVE TESTING OF WELDED JOINTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 341-16: Section J6.2		
TASK	INSPECTION TYPE [1]	DESCRIPTION
5. CJP groove welds	OBSERVE	Dye penetrant testing (DT) and ultrasonic testing (UT) shall be performed on 100% of CJP groove welds for materials greater than 5/16" thick (8mm).
6. Beam cope and access hole.	OBSERVE	At welded splices and connections, thermally cut surfaces of beam copes and access holes shall be tested using magnetic particle testing (MT) or dye penetrant testing (DT), when the flange thickness exceeds 1 1/2 in. for rolled shapes, or when the web thickness exceeds 1 1/2 in. for built-up shapes.
7. K-area NDT (AISC 341)	**PERFORM**	Where welding of doubler plates, continuity plates or stiffeners has been performed in the k-area, the web shall be tested for cracks using magnetic particle testing (MT). The MT inspection area shall include the k-area base metal within 3-inches of the weld. The MT shall be performed no sooner than 48 hours following completion of the welding.
8. Placement of reinforcing or contouring fillet welds	**DOCUMENT**	

END SECTION

[1] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - STEEL - COMPOSITE CONSTRUCTION [1]

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

COMPOSITE CONSTRUCTION PRIOR TO PLACING CONCRETE – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table N6.1, AISC 341-16: Table J9.1		
TASK	INSPECTION TYPE [2]	DESCRIPTION
1. Placement and installation of steel headed stud anchors	**PERFORM**	
2. Material identification of reinforcing steel (Type/Grade)	OBSERVE	
3. Determination of carbon equivalent for reinforcing steel other than ASTM A706	OBSERVE	
4. Proper reinforcing steel size, spacing, clearances, support, and orientation	OBSERVE	
5. Reinforcing steel has not been re-bent in the field	OBSERVE	
6. Reinforcing clearances have been provided	OBSERVE	
7. Reinforcing steel has been tied and supported as required	OBSERVE	
8. Composite member has required size	OBSERVE	

END SECTION

STRUCTURAL - STEEL - OTHER INSPECTIONS

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

OTHER STEEL INSPECTIONS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 341-16: Tables J8.1 & J10.1		
TASK	INSPECTION TYPE [2]	DESCRIPTION
1. Anchor rods and other embedments supporting structural steel	**PERFORM**	Verify the diameter, grade, type, and length of the anchor rod or embedded item, and the extent or depth of embedment prior to placement of concrete.
2. Fabricated steel or erected steel frame	OBSERVE	Verify compliance with the details shown on the construction documents, such as braces, stiffeners, member locations and proper application of joint details at each connection.
3. Reduced beam sections (RBS) where/if occurs	**DOCUMENT**	✓ Contour and finish ✓ Dimensional tolerances
4. Protected zones	**DOCUMENT**	No holes or unapproved attachments made by fabricator or erector
5. H-piles where/if occurs	**DOCUMENT**	No holes or unapproved attachments made by the responsible contractor

END SECTION

[1] See Concrete Construction Section for all concrete related inspection of composite steel construction.

[2] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - COLD-FORMED METAL DECK - PLACEMENT SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

METAL DECK INSPECTION PRIOR TO DECK PLACEMENT – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.1		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Verify compliance of materials (deck and all deck accessories) with construction documents, including profiles, material properties, and base metal thickness	**PERFORM**	
2. Document acceptance or rejection of deck and deck accessories	**DOCUMENT**	
METAL DECK INSPECTION DURING DECK PLACEMENT – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.2		
TASK	INSPECTION TYPE [1]	DESCRIPTION
3. Verify compliance of deck and all deck accessories installation with construction documents	**PERFORM**	
4. Verify deck materials are represented by the mill certifications that comply with the construction documents	**PERFORM**	
5. Document acceptance or rejection of installation of deck and deck accessories	**DOCUMENT**	
METAL DECK INSPECTION AFTER DECK PLACEMENT – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.3		
TASK	INSPECTION TYPE [1]	DESCRIPTION
6. Welding procedure specification (WPS) available	**PERFORM**	
7. Manufactures certifications for welding consumables available	OBSERVE	
8. Material identification (type/grade)	OBSERVE	
9. Check welding equipment	OBSERVE	

END SECTION

[1] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - COLD-FORMED METAL DECK – WELDING SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

METAL DECK INSPECTION DURING WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.4		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Use of qualified welders	OBSERVE	
2. Control and handling of welding consumables	OBSERVE	
3. Environmental conditions (wind speed, moisture, temperature)	OBSERVE	
4. WPS followed	OBSERVE	
METAL DECK INSPECTION AFTER WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.5		
TASK	INSPECTION TYPE [1]	DESCRIPTION
5. Verify size and location of welds, including support, sidelap, and perimeter welds.	**PERFORM**	
6. Welds meet visual acceptance criteria	**PERFORM**	
7. Verify repair activities	**PERFORM**	
8. Document acceptance or rejection of welds	**DOCUMENT**	

END SECTION

[1] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - COLD-FORMED METAL DECK – FASTENING SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

METAL DECK INSPECTION BEFORE MECHANICAL FASTENING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.6		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Manufacturer installation instructions available for mechanical fasteners	OBSERVE	
2. Proper tools available for fastener installation	OBSERVE	
METAL DECK INSPECTION DURING MECHANICAL FASTENING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.7		
TASK	INSPECTION TYPE [1]	DESCRIPTION
3. Fasteners are positioned as required	OBSERVE	
4. Fasteners are installed in accordance with manufacturer's instructions	OBSERVE	
METAL DECK INSPECTION AFTER MECHANICAL FASTENING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.8		
TASK	INSPECTION TYPE [1]	DESCRIPTION
5. Check spacing, type, and installation of support fasteners	**PERFORM**	
6. Check spacing, type, and installation of sidelap fasteners	**PERFORM**	
7. Check spacing, type, and installation of perimeter fasteners	**PERFORM**	
8. Verify repair activities	**PERFORM**	
9. Document acceptance or rejection of mechanical fasteners	**DOCUMENT**	

END SECTION

[1] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - LIGHT GAUGE STEEL FRAMING AND/OR LIGHT GAUGE TRUSSES SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

LIGHT GAUGE STEEL CONSTRUCTION AND CONNECTIONS – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.2.2, 1705.11.2, 1705.11.3, UFC 4 023 03		
TASK	INSPECTION TYPE[1]	DESCRIPTION
1. Trusses spanning 60-feet or greater where/if applies	**PERFORM**	Verify that temporary and permanent truss restraint/bracing is installed in accordance with approved truss submittal package.
2. Welded connections (seismic and/or wind resisting system)	OBSERVE	Visually inspect all welds composing part of the main wind or seismic force resisting system, including shearwalls, braces, collectors (drag struts), and hold-downs.
3. Connections (seismic and/or wind resisting system)	OBSERVE	Visually inspect all screw attachment, bolting, anchoring and other fastening of components within the main wind or seismic force resisting system, including roof deck, roof framing, exterior wall covering, wall to roof/floor connections, braces, collectors (drag struts) and hold-downs.
4. Cold-formed steel (progressive collapse resisting system where/if applies)	OBSERVE	Verify proper welding operations, screw attachment, bolting, anchoring and other fastening of components within the progressive collapse resisting system, including horizontal tie force elements, vertical tie force elements and bridging elements (UFC 4 023 03).

END SECTION

STRUCTURAL - OPEN-WEB STEEL JOISTS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

OPEN-WEB STEEL JOISTS AND JOIST GIRDERS – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC TABLE 1705.2.3		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Installation of open-web steel joists and joist girders	OBSERVE	✓ End connections – welded or bolted ✓ Bridging – horizontal and diagonal

END SECTION

[1] **PERFORM**: Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

STRUCTURAL - CONCRETE CONSTRUCTION SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

CONCRETE CONSTRUCTION, INCLUDING COMPOSITE DECK – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC TABLE 1705.3 (ACI 318 REFERENCES NOTED IN IBC TABLE)		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Inspect reinforcement, including prestressing tendons, and verify placement.	OBSERVE	Verify prior to placing concrete that reinforcing is of specified type, grade and size; that it is free of oil, dirt and unacceptable rust; that it is located and spaced properly; that hooks, bends, ties, stirrups and supplemental reinforcement are placed correctly; that lap lengths, stagger and offsets are provided; and that all mechanical connections are installed per the manufacturer's instructions and/or evaluation report.
2. Reinforcing bar welding	OBSERVE	✓ Verify weldability of reinforcing bars other than ASTM A 706 ✓ Inspect single-pass fillet welds, maximum 5/16" in accordance with AWS D1.4
3. All other welding	**CONTINUOUS**	Visually inspect all welds in accordance with AWS D1.4
4. Cast in place anchors and post installed drilled anchors (downward inclined)	OBSERVE	Verify prior to placing concrete that cast in place anchors and post installed drilled anchors have proper embedment, spacing and edge distance.
5. Post-installed adhesive anchors in horizontal or upward inclined orientations	**CONTINUOUS AND DOCUMENT**	✓ Inspect as required per approved ICC-ES report ✓ Verify that installer is certified for installation of horizontal and overhead installation applications ✓ Inspect proof loading as required by the contract documents
6. Verify use of required mix design	OBSERVE	Verify that all mixes used comply with the approved construction documents
7. Prior to concrete placement, fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete	**CONTINUOUS**	At the time fresh concrete is sampled to fabricate specimens for strength test verify these tests are performed by qualified technicians.
8. Inspect concrete and/or shotcrete placement for proper application techniques	**CONTINUOUS**	Verify proper application techniques are used during concrete conveyance and depositing avoids segregation or contamination. Verify that concrete is properly consolidated.
9. Verify maintenance of specified curing temperature and technique	OBSERVE	Inspect curing, cold weather protection, and hot weather protection procedures.
10. Pre-stressed concrete	**CONTINUOUS**	Verify application of prestressing forces and grouting of bonded prestressing tendons.

CONTINUED ON FOLLOWING PAGE

[1] **OBSERVE**: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.
CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

STRUCTURAL - CONCRETE CONSTRUCTION (CONTINUED)

CONCRETE CONSTRUCTION, INCLUDING COMPOSITE DECK – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC TABLE 1705.3 (ACI 318 REFERENCES NOTED IN IBC TABLE)		
TASK	INSPECTION TYPE [1]	DESCRIPTION
11. Inspect erection of precast concrete members	OBSERVE	
12. Verify in-situ concrete strength, prior to stressing of tendons in post-tensioned concrete and prior to removal of shores and forms from beams and structural slabs.	OBSERVE	
13. Inspect formwork for shape, location and dimensions of the concrete member being formed.	OBSERVE	

END SECTION

[1] **OBSERVE**: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.
CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

STRUCTURAL - MASONRY CONSTRUCTION SECTION (ALL RISK CATEGORIES)

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

MASONRY CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE AT START OF CONSTRUCTION IBC 1705.4 (ACI 530-13 TABLE 3.1.2 & 3.1.3)		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Compliance with approved submittals prior to start	OBSERVE	
2. Proportions of site-mixed mortar.	OBSERVE	
3. Grade and type of reinforcement, anchor bolts, and prestressing tendons and anchorages	OBSERVE	
4. Prestressing technique	OBSERVE	
5. Properties of thin bed mortar for AAC masonry	OBSERVE	
MASONRY CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE PRIOR TO GROUTING IBC 1705.4 (ACI 530-13 TABLE 3.1.2 & 3.1.3)		
TASK	INSPECTION TYPE [1]	DESCRIPTION
6. Grout space	OBSERVE	
7. Proportions of site-prepared grout and prestressing grout for bonded tendons	OBSERVE	
8. Proportions of site-mixed grout and prestressing grout for bonded tendons	OBSERVE	
9. Placement of masonry units and mortar joints	OBSERVE	
10. Welding of reinforcement	**CONTINUOUS**	
MASONRY CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE DURING CONSTRUCTION IBC 1705.4 (ACI 530-13 TABLE 3.1.2 & 3.1.3)		
TASK	INSPECTION TYPE [1]	DESCRIPTION
11. Size and location of structural elements is in compliance	OBSERVE	
12. Preparation, construction, and protection of masonry during cold weather (temperature below 40°F (4.4°c) or hot weather (temp above 90°F (32.2°C))	OBSERVE	
13. Application and measurement of prestressing force	**CONTINUOUS**	
14. Placement of grout and prestressing grout for bonded tendons	**CONTINUOUS**	
15. Placement of AAC masonry units and construction of thin bed mortar joints	**CONTINUOUS**	Continuous for first 5000 square feet only (465 square meters).
16. Observe preparation of grout specimens, mortar specimens, and/or prisms	OBSERVE	
17. Type, size and placement of reinforcement, connectors, anchor bolts and prestressing tendons and anchorages, including details of anchorage of masonry to structural members, frames, or other construction	OBSERVE	

END SECTION

[1] **OBSERVE**: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

STRUCTURAL - WOOD CONSTRUCTION – SPECIALTY ITEMS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

WOOD CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.5		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. High-load diaphragms where applicable	OBSERVE	Verify thickness and grade of sheathing, size of framing members at panel edges, nail diameters and length, and the number of fastener lines and that fastener spacing is per approved contract documents.
2. Metal-plate connected wood trusses spanning 60 feet or greater	OBSERVE	Verify that the temporary installation restraint/bracing and the permanent individual truss member restraint/bracing are installed in accordance with the approved truss submittal package

END SECTION

STRUCTURAL - WOOD CONSTRUCTION - SEISMIC & WIND SECTION

THIS SECTION IS APPLICABLE IF BOX IS CHECKED: ☐

WOOD CONSTRUCTION SEISMIC AND WIND – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.11 & 1705.12.2		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Nailing, bolting, anchoring and other fastening of elements of the main wind/seismic force-resisting system	OBSERVE (CONTINUOUS FOR GLUING)	Includes connectors for: shearwall sheathing, roof/floor sheathing, drag struts/collectors (double top plates), braces, hold downs, roof connections to exterior walls.

END SECTION

STRUCTURAL – ISOLATION AND ENERGY DISSIPATION SYSTEMS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

ISOLATION AND ENERGY DISSIPATION SYSTEMS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC TABLE 1705.12.8		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Fabrication and installation	OBSERVE	Verify that fabrication and installation of isolator units and energy dissipation devices conform to manufacturer's recommendations and approved construction documents
2. Testing of seismic isolation Systems in seismically isolated structures		Seismic Isolation Systems in seismically isolated structures shall be tested accordance with ASCE 7, Section 17.8

END SECTION

[1] **OBSERVE**: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

GEOTECHNICAL - SOILS INSPECTION SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

SOILS INSPECTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.6		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Materials below shallow foundations are adequate to achieve the design bearing capacity.	OBSERVE	
2. Excavations are extended to proper depth and have reached proper material	OBSERVE	
3. Perform classification and testing of compacted fill materials	**OBSERVE**	
4. Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill	**CONTINUOUS**	
5. Prior to placement of compacted fill, inspect subgrade and verify that site has been prepared properly.	OBSERVE	During fill placement, the special inspector shall verify that proper materials and procedures are used in accordance with the provisions of the approved geotechnical report

END SECTION

GEOTECHNICAL - DRIVEN DEEP FOUNDATION ELEMENTS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

DEEP DRIVEN FOUNDATION CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.7		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Verify element materials, sizes and lengths comply with requirements	**CONTINUOUS**	
2. Inspect driving operations and maintain complete and accurate records for each element	**CONTINUOUS**	
3. Verify placement locations and plumbness, confirm type and size of hammer, record number of blows per foot of penetration, determine required penetrations to achiever design capacity, record tip and butt elevations and document any damage to foundation element	**CONTINUOUS**	
4. Determine capacities of test elements and conduct additional load tests if required.	**CONTINUOUS**	
5. For steel or concrete elements, perform additional special inspections in accordance with the Steel and Concrete sections in this schedule		

END SECTION

[1] **OBSERVE**: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

GEOTECHNICAL - HELICAL PILE FOUNDATIONS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

HELICAL PILE FOUNDATIONS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.9		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Record installation equipment used, pile dimensions, tip elevations, final depth, final installation torque and other pertinent installation data as required. The approved geotechnical report and the contract documents shall be used to determine compliance	**CONTINUOUS**	

END SECTION

GEOTECHNICAL - CAST IN PLACE DEEP FOUNDATION ELEMENTS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

CAST IN PLACE DEEP FOUNDATION ELEMENTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.8		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Inspect drilling operations and maintain complete and accurate records for each element.	**CONTINUOUS**	
2. Verify placement locations and plumbness, confirm element diameters, bell diameters (if applicable), lengths, embedment into bedrock (if applicable) and adequate end-bearing strata capacity. Record concrete or grout volumes	**CONTINUOUS**	For concrete elements, perform additional special inspections in accordance with the Concrete section in this schedule

END SECTION

[1] **CONTINUOUS:** Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

FIRE PROTECTION - SPRAYED FIRE-RESISTANT MATERIALS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

SPRAYED FIRE RESISTANT MATERIALS (SFRM) – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.14		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Substrate condition	OBSERVE	Prior to application, confirm that surfaces have been prepared according to the approved fire-resistance design and manufacturer's instructions.
2. Material thickness	OBSERVE	Verify SFRM thickness according to 2018 IBC 1705.14.4
3. Material density	OBSERVE	Verify SFRM density according to 2018 IBC 1705.14.5
4. Bond strength	OBSERVE	Verify bond strength of cured SFRM according to IBC 1705.14.6

END SECTION

FIRE PROTECTION - MASTIC AND INTUMESCENT COATINGS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

MASTIC AND INTUMESCENT FIRE-RESISTANT COATINGS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.15		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Inspect according to AWCI 12-B and the contract documents	OBSERVE	Inspections shall be performed in accordance with AWCI 12-B, Standard Practice for the Testing and Inspection of Field Applied Thin Film Intumescent Fire-Resistive Materials.

END SECTION

FIRE PROTECTION – FIRE RESISTANT PENETRATIONS AND JOINTS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

FIRE RESISTANT PENETRATIONS AND JOINTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.17		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Inspections of penetration firestop systems conducted in accordance with ASTM E 2174.	OBSERVE	
2. Inspections of fire-resistant joint systems conducted in accordance with ASTM E 2393	OBSERVE	

END SECTION

[1] **OBSERVE**: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

FIRE PROTECTION – SMOKE CONTROL SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒

SMOKE CONTROL – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.18		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Verify device locations and perform leakage testing	OBSERVE	Perform during erection of ductwork and prior to concealment
2. Pressure difference testing, flow measurements and detection and control verification	OBSERVE	Perform prior to occupancy and after sufficient completion

END SECTION

[1] **OBSERVE**: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

ARCHITECTURAL - EXTERIOR INSULATION AND FINISH SYSTEMS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

EXTERIOR INSULATION AND FINISH SYSTEMS (EIFS) – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.16		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Water resistive barrier coating applied over a sheathing substrate.	OBSERVE	Verify that water resistive barrier coating complies with ASTM E 2570.

END SECTION

ARCHITECTURAL – ARCHITECTURAL COMPONENTS

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

ARCHITECTURAL COMPONENTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.12.5, 1705.12.7		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Erection and fastening of exterior cladding and interior and exterior veneer.	OBSERVE	Verify appropriate materials, fasteners and attachment at commencement of work and at completion. **Inspector Note: Inspection not required if height is less than 30 feet or weight is less than 5psf**
2. Interior and exterior non-load bearing walls	OBSERVE	Verify appropriate materials, fasteners and attachment at commencement of work and at completion. **Inspector Note: Inspection not required if interior non-load bearing walls weigh less than 15psf**
3. Access floors	OBSERVE	Verify that anchorage complies with approved construction documents.
4. Storage racks	OBSERVE	Verify that anchorage complies with approved construction documents. Inspection of post-installed anchors shall comply with approved ICC-ES report. **Inspector Note: Not required for racks less than 8 feet in height**

END SECTION

[1] **OBSERVE**: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

PLUMBING/MECHANICAL/ELECTRICAL DESIGNATED SEISMIC SYSTEMS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐

PLUMBING, MECHANICAL AND ELECTRICAL IBC 1705.12.6		
TASK	INSPECTION TYPE [1]	DESCRIPTION
1. Anchorage of electrical equipment for emergency and standby power systems	OBSERVE	✓ Check for general conformance
2. Anchorage of all other electrical equipment in Seismic Design Categories E and F only (See first page of this schedule for Seismic Design Category)	OBSERVE	✓ Check for general conformance
3. Installation and anchorage of piping designed to carry hazardous materials and their associated mechanical units.	OBSERVE	✓ Check for general conformance
4. Installation and anchorage of vibration isolation systems where the construction documents require a nominal clearance of ¼" or less between support framing and restraint.	OBSERVE	✓ Check for general conformance
5. Verification of clearance between fire sprinkler piping and surrounding mechanical and electrical equipment, including ductwork, piping and their structural supports.	OBSERVE	✓ Check for minimum clearances noted in ASCE7 13.2.3 or a nominal clearance of not less than 3 inches

END SECTION

[1] **OBSERVE**: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

1.2 USE CHARGES

A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Engineer, occupants of Project, testing agencies, and authorities having jurisdiction.

B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without payment of use charges. Provide connections and extensions of services as required for construction operations. Provide appropriate backflow prevention device and meter acceptable to Town Water Department on all connections.

C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.3 INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

B. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content. See Supplementary Conditions, Article 18.

C. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of SWPPP, attached hereto.

D. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

E. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.

1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
3. Indicate methods to be used to avoid trapping water in finished work.

1.4 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Accessible Temporary Egress: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.5 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

A. Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Field Office: Of sufficient size to accommodate needs of Owner, Engineer, and office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:

1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
2. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot-square tack and marker boards.
3. Drinking water and private toilet.
4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.

5. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.
6. WiFi and wired internet access.

2.2 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 017700 "Closeout Procedures."

C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers to municipal system or private system indicated as directed by authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction. All service connections to include backflow prevention device and meter.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.

F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.

G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

1. Install electric power service overhead unless otherwise indicated.

H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

I. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Engineer and Owner.

J. Project IT: Provide IT equipment in primary field office as follows:

1. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these three functions.

2. Internet Service: Broadband modem, router, and ISP, equipped with hardware firewall, providing minimum 20.0 -Mbps upload and 100.0 -Mbps download speeds at each computer.

3.4 SUPPORT FACILITIES INSTALLATION

A. Comply with the following:

1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E136. Comply with NFPA 241.
2. Utilize designated area for temporary field offices.
3. Maintain support facilities until Engineer schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas as indicated on Drawings.

1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

D. Parking: Provide temporary offsite or use designated areas as shown on the site plans. Provide stabilized dust free surface.

E. Storage and Staging: Provide temporary offsite area or use designated areas of Project site for storage and staging needs.

F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

G. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings or specifications.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

    a. Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touch up signs so they are legible at all times.

H. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

I. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."

J. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

K. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

L. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.

1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.

M. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

C. Temporary Erosion and Sedimentation Control: Comply with requirements of Stormwater Pollution Prevention Plan (SWPPP) or requirements specified in Section 312500 “Erosion and Sediment Control”, whichever is more stringent.

D. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent

properties and walkways, according to erosion- and sedimentation-control Drawings, requirements of the SWPPP or authorities having jurisdiction, whichever is more stringent.

1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

E. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

F. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

G. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.

H. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations or as indicated on Drawings.
2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.

I. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.

J. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

K. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.

L. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

M. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner and tenants from fumes and noise.

1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
2. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
3. Provide walk-off mats at each entrance through temporary partition.

N. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.

1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.6 MOISTURE AND MOLD CONTROL

A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.

B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard and replace stored or installed material that begins to grow mold.

7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.

D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

3.7 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

015500 - MAINTENANCE AND PROTECTION OF TRAFFIC (NY)

PART 1 – GENERAL

1.1 WORK INCLUDED:

A. Maintain traffic and protect the public from damage to person and property within limits of and for duration of the Contract.

B. Provide all such signs, flag-persons, delineation and/or other methods as necessary so that a person who has no knowledge of conditions can safely and with a minimum of discomfort and inconvenience, ride, drive or walk over all or any portion of the street under construction where traffic is to be maintained.

C. Maintain a reasonably smooth traveled way, acceptable to the Engineer, for movement of traffic.

D. Maintain, at all times, access to all properties for emergency vehicles and services.

E. Control dust and keep the traveled way free from materials spilled from hauling equipment. This shall also apply to dust control and spilled material resulting from the Contractor's operations in areas outside the contract limits.

F. Ensure conformance with this Section for all work performed by this Contractor and/or any Subcontractor thereof.

1.2 EXISTING CONDITIONS:

A. It shall be the Contractor's responsibility to investigate all site conditions that may affect his work.

B. It shall be the Contractor's responsibility to notify all appropriate jurisdictions, make any and all applications and comply with all requirements involved with the Maintenance and Protection of Traffic in compliance with all State and/or Local codes or requirements.

1.3 NECESSITY AND IMPORTANCE:

A. The Contractor is placed on notice that Maintenance and Protection of Traffic over any street, road, highway or accessway during construction is to be considered as important and necessary an item of work as is the actual construction itself. The Contractor shall at all times conduct his operation in a manner to insure the safety of not only the public and motorists, but also pedestrians and his own employees.

B. The Contractor shall protect the user from damage to person and property by reason of any construction operation (for example excavation, paving, tree work, demolition, etc.) by such

protective screens, devices, signs, or methods.

1.4 REFERENCES:

A. All layouts, devices, signs, methods and procedures for all work under this Section shall comply with the requirements referenced in the National Manual on Uniform Traffic Control (MUTCD) and the New York State Supplement to the National MUTCD, years of latest revision.

PART 2 - MATERIALS

2.1 SIGNS:

A. All temporary signs, delineators, barricades, warnings, lights and other warning and guiding devices shall comply with the requirements of the National MUTCD and the New York State Supplement to the National MUTCD, except as otherwise specified, and shall remain the property of the Contractor.

B. All temporary signs, delineators and other warning and guiding devices shall conform to the requirements of the Agency having jurisdiction on the roadway(s) wherein the contract work is being performed.

PART 3 - CONSTRUCTION DETAILS

3.1 GENERAL:

A. Contractor shall generally provide a travel way suitable for one or more lanes of traffic. The way of travel shall be kept well drained and reasonably smooth and hard at all times and free of the potholes, bumps, irregularities and depressions that hold or retain water. The Contractor shall conduct his operations to insure a minimum of delay to the traffic. Stopping traffic for more than approximately five (5) minutes is considered unsatisfactory. Necessary equipment and personnel to attain and maintain a satisfactory riding surface shall be available and used as needed at all times, both when the work is under way and when the work is temporarily suspended for any period of time. Special attention shall be given to maintenance of a satisfactory way of travel over weekends, holidays and during the winter season, if applicable.

B. Contractor shall keep the travel way free of foreign objects such as rocks, timber and other items that may fall from the transporting vehicles. Spillage of material carried by or dropped from the undercarriage of any carrying vehicle resulting from the Contractor's hauling operations along or across any public traveled way shall be removed immediately and such travel way, both within and outside of the contract limits shall be kept free of such spillage by the Contractor. The Contractor shall also provide a sufficient number of competent flag-persons in areas where traffic is congested, particularly where construction equipment is operating.

C. Contractor shall maintain all elements of the street beginning on the date of execution of the contract and ending on the date the contract is accepted by the Owner. He shall provide an adequate travel way as specified. He shall devote particular attention to all the drainage facilities, keeping them fully operative at all times. Contractor will be required to plow snow or control ice on the travel way.

D. He shall be responsible for the moving of any plowed snow that may be necessary to adequately maintain any element of the street, and he will be responsible for the moving of any plowed snow from in front of driveways or entrances. Any damage to any portion of the work occasioned by lack of adequate maintenance shall be repaired by the Contractor at his own expense.

E. Contractor shall provide and maintain at all times a safe and adequate ingress and egress to and from intersecting streets, homes, businesses and commercial establishments at existing or at new access points.

F. Contractor shall furnish and erect reflectorized signs for the information of the motorist and to adequately and legally post the street under construction as to its status in compliance with the National MUTCD and the New York State Supplement to the National MUTCD.

G. All signs shall be kept clean, mounted at the approved height and placed so as to be effective both day and night. Signs, warnings, delineators and barricades shall be used to adequately inform the motorist of any unusual or unsafe conditions and to safely and clearly guide him through the contract area. Such signs, warnings, or devices shall be placed so as to give timely warning and permit the motorist to take the necessary action to traverse the area safely.

H. Shall maintain free access to every utility manhole and/ or box, fire hydrant or alarm box, valve box, valve chamber, etc.

I. Dusty conditions resulting from the Contractor's operation, in the opinion of the Engineer, Owner or Agency responsible for the roadway, shall be corrected with application of water and broomed. Water used as a dust palliative shall be distributed uniformly over a minimum width of eight feet by the use of suitable spray heads or spray bars. The brooms shall be of sufficient force to effectively remove any foreign material on the wetted surface, without spraying or splashing the material onto adjacent structures, automobiles, buildings, pedestrians, etc. The Contractor may not use public or private water systems for these purposes without permission and/or payment to the system owner.

3.2 MAINTENANCE:

A. Contractor is to maintain existing traffic control devices such as signs, etc.

B. If temporary removal during construction is necessary, temporary signs should be installed to maintain traffic control in a like manner.

C. Traffic control devices shall be replaced, if damaged during the construction operations; removal, storage or replacement of the item shall be by the Contractor at his own expense.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT:

A. Unless otherwise specified in the Proposal or on the Plans, the Contractor shall, under this item, be responsible for the maintenance within the limits of the Contract of the entire pavement, drainage facilities and other street elements both old and new beginning on the date the Contract is executed and ending on the date the Contract is officially finally accepted.

4.2 FAILURE TO COMPLY:

A. In the event that, in the judgement of the Owner and/or Engineer, traffic is not adequately maintained on any part of the contract, on any day, no payment for maintenance and protection of traffic will be made for that day. The amount of such daily non-payment will be determined by dividing the lump sum amount bid for this item by the number of calendar days between the date of award and the date of completion as designated in the proposal without regard to any extension of time. These amounts may be deducted from any monies due to the Contractor on this Contract.

B. If the Contractor fails to maintain and protect traffic adequately and safely for a period of 24 hours, the Owner may correct the adverse conditions by the use of Municipal Forces, augmented if necessary, by other equipment and personnel as it may be necessary to hire, and the entire cost of this work by such forces shall be deducted from any monies due the Contractor on this contract. The cost of this work shall be in addition to daily non-payment deductions listed above, and shall not be limited to the lump sum bid amount for this item.

4.3 PAYMENT:

A. Maintenance and Protection of Traffic shall be paid for on a lump sum basis; at the price bid for this item, less any deductions for the unsatisfactory accomplishment, as determined above. The price bid shall include the cost of furnishing all labor, materials and equipment necessary to satisfactorily complete the work and comply with all requirements herein.

B. If no separate Payment Item is provided in the Proposal for Maintenance and Protection of Traffic, then all work required under this Section shall be deemed included under the other payment items of the Proposal.

C. Price bid shall also include the cost of any detour, temporary pavement or temporary structure not shown on the plans or in the proposal. Payments will be made for this item in

proportion to the total amount of work completed, less any amounts deducted for unsatisfactory accomplishment.

D. In view of the difficulty of accurately ascertaining the cost to the Owner in indirect impacts as caused by the Contractor's failure to properly accomplish this item of work, any monies deducted for unsatisfactory accomplishment shall not be refundable to the Contractor in any case.

E. The amount of actual costs incurred by the Owner (and reimbursement thereof) to properly maintain and protect traffic upon the failure of the Contractor to do so shall not be limited to the amount bid by the Contractor in the Proposal.

END OF SECTION 015500 (NY)

Section 01 58 00 Specification for New York State Environmental Facilities Corporation Financing Signage

PART 1 GENERAL

1.1 SUMMARY

A. This specification covers the fabrication and installation of a construction sign for facilities receiving funding from the New York State Environmental Facilities Corporation (EFC) through the Clean Water State Revolving Fund (CWSRF), Drinking Water State Revolving Fund (DWSRF), New York State Water Infrastructure Improvement (WIIA) or Intermunicipal Grants (IMG) programs, Green Innovation Grant Program (GIGP), or Overflow and Stormwater Grants (OSG). Facilities receiving CWSRF or DWSRF funds made available through the federal Bipartisan Infrastructure Law (BIL) are required to post an additional BIL specific sign. See https://www.epa.gov/invest/investing-america-signage

1.2 RELATED SECTIONS

A. None

1.3 SUBMITTALS

A. Shop Drawings: In compliance with direction from the Owner, the Contractor shall prepare and submit a site plan and mock-up of temporary project signs.

PART 2 PRODUCTS

2.1 GENERAL

A. The sign(s) shall be fabricated and erected within 21 days following the notice to proceed on the first contract at the facility and shall be maintained by site Contractors, as directed by the Owner, until final construction completion for all funded projects at the facility.

B. For facilities with funding from multiple sources, the logos outlined below must be included on a single project sign including the text “Funded by”, as approved by the funding agencies.

C. ~~There should be one project sign unless the facility is receiving CWSRF or DWSRF funds made available through BIL. If the project has multiple locations, one project sign centrally located as directed by the Owner is acceptable~~.

~~If project is receiving funds made available through BIL:~~ ~~Facilities must also place a 72" (w) x 48" (h) Bipartisan Infrastructure Law sign. https://www.epa.gov/system/files/documents/2023-04/WHITE%20Background%20Bipartisan%20Infrastructure%20Law%20Signage.pdf~~

D. The attached EFC Project Sign Schematic aligning with funding anticipated for this project shall be used when no other sign exists.

2.2 MATERIALS AND FABRICATION

A. Sign Panel: The sign panel shall be constructed of 3/4" minimum thickness marine plywood rabbeted into a 2"x4" lumber frame or other such materials capable of withstanding typical weather conditions common to the project area. Use of recycled or recovered materials is encouraged.

B. Fasteners: All fasteners used in the fabrication of the sign shall be rust-proof.

C. Sign Supports: The sign shall be adequately supported and braced to remain in the proper positioning and alignment, including resistance to wind loads and toppling of the sign.

E. Coating: All paint or exterior coverings used shall be exterior grade coating suitable for use on wood or the material of construction. The sign face background and sign back shall be white and consist of a minimum two coats of paint.

F. Lettering and Emblem: The sign shall include the following logos in an aspect ratio consistent with other lettering on the sign but not less than a height of 2.0".

1. The EFC logo available at https://efc.ny.gov/efc-logo-pdf

2. ~~For DWSRF, DW WIIA, or DW IMG projects: The New York State Department of Health (DOH) logo available at~~ https://efc.ny.gov/efc-doh-logo

3. For CWSRF, OSG, and DWSRF projects: The EPA logo available at https://efc.ny.gov/epa-logo, consistent with the EPA

Logo & Seal Specifications for Signage Produced by EPA Assistance Agreement Recipients as outlined in https://www.epa.gov/sites/default/files/2015-01/documents/epa_logo_seal_specifications_for_infrastructure_grants.pdf

4. For CWSRF projects incorporate the following language:

   This project is jointly funded by the New York State Clean Water State Revolving Fund and the U.S. Environmental Protection Agency. The CWSRF is administered by the New York State Environmental Facilities Corporation

5. For DWSRF projects incorporate the following language:

   This project is jointly funded by the New York State Drinking Water State Revolving Fund and the U.S. Environmental Protection Agency. The DWSRF is administered by the New York State Environmental Facilities Corporation with its partner the New York State Department of Health

PART 3 EXECUTION

3.1 INSTALLATION

A. The project sign shall be erected in the location and alignment, as directed by the Engineer or the Owner, with the bottom of the sign panel a minimum of five feet above existing grade.

3.2 MAINTENANCE

A. The Contractor shall provide all materials required to maintain the sign in good condition throughout the duration of the work.

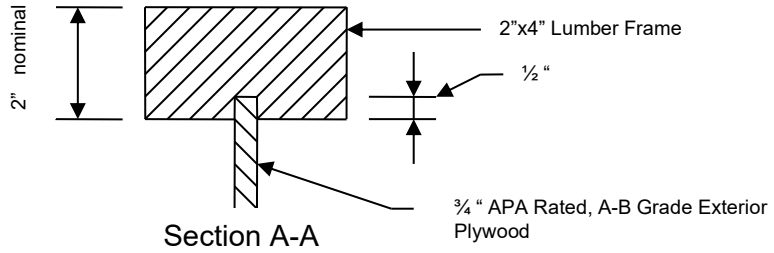
B. Upon notification of the Owner, the Contractor shall remove the sign from the construction site.

End of Section

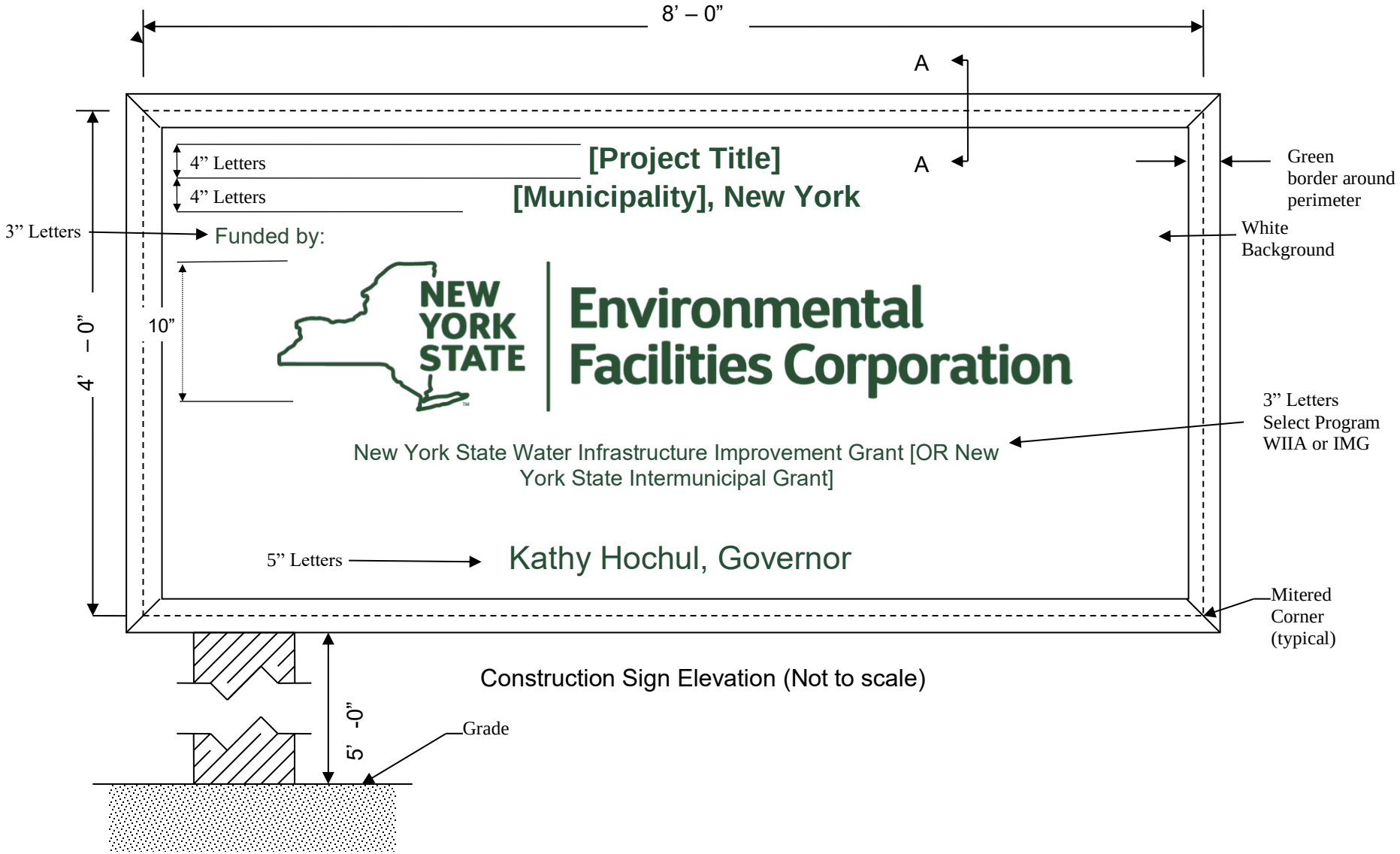
EFC CONSTRUCTION SIGN SCHEMATIC:
Clean Water WIIA/IMG

Note: All lettering shall be green based on the color specification listed at right, except as noted. Font shall be Arial. Spacing between lines shall be 1" except as noted.

PANTONE
350 C
CMYK 80/21/79/64
RGB 44/82/52
HEX #2C5234



Section A-A



Construction Sign Elevation (Not to scale)

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

1.2 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.

1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the

specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:

1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.

E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."

1.3 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

1.5 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.

2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

B. Product Selection Procedures:

1. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

    a. Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."

2. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.

    a. Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."

3. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered.

    a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."

4. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.

    a. Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
    b. Provision of an unnamed product is not considered a substitution, if the product complies with requirements.

5. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered.

    a. Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."

6. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.

    a. Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
    b. Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.

7. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

C. Visual Matching Specification: Where Specifications require the phrase "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

    1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

E. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated requirements. Comply with

requirements in Division 01 sustainability requirements Section and individual Specification Sections.

1. Select products for which sustainable design documentation submittals are available from manufacturer.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:

1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."

1. Form of Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

C. Submittal Requirements, Two-Step Process: Approval by the Architect of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.

D. Submittal Requirements, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner's portion of the Work.
6. Coordination of Owner-installed products.
7. Progress cleaning.
8. Starting and adjusting.
9. Protection of installed construction.

B. Related Requirements:

1. Section 011000 "Summary" for coordination of Owner-furnished products, Owner-performed work, and/or Owner's separate contracts, and limits on use of Project site.
2. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
3. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.

1.2 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.3 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Engineer of locations and details of cutting and await directions from Engineer before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Engineer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Engineer for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before

fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Engineer in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Engineer promptly.

B. Engage a land surveyor or professional engineer experienced in laying out the Work, using the following accepted surveying practices:

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Engineer when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Engineer.

3.4 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Engineer. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Engineer before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

E. Final Property Survey: Engage a land surveyor or professional engineer to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor or professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.

3.5 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb, and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure satisfactory results as judged by Engineer. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.

F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.

G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Engineer.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Engineer. Fit exposed connections together to form hairline joints.

J. Repair or remove and replace damaged, defective, or nonconforming Work.

1. Comply with Section 017700 "Closeout Procedures" for repairing or removing and replacing defective Work.

3.6 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.

C. Temporary Support: Provide temporary support of Work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Engineer. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend from one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 COORDINATION OF OWNER'S PORTION OF THE WORK

A. Site Access: Provide access to Project site for Owner's construction personnel and Owner's separate contractors.

1. Provide temporary facilities required for Owner-furnished, Contractor-installed products.
2. Refer to Section 011000 "Summary" for other requirements for Owner-furnished, Contractor-installed products

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel and Owner's separate contractors.

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.

3.8 PROGRESS CLEANING

A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

a. Use containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls."

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.10 PROTECTION AND REPAIR OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

C. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

D. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.
3. Disposing of nonhazardous demolition and construction waste.

B. Related Requirements:

1. Section 024119 "Selective Demolition”.

1.2 DEFINITIONS

A. Construction Waste: Structure, and site improvement materials and other solid waste resulting from construction, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Structure, and site improvement materials resulting from demolition operations.

C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 30 days of date established for the Notice to Proceed.

1.4 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Include the following information:

1. Material category.
2. Generation point of waste.
3. Total quantity of waste in tons.
4. Quantity of waste salvaged, both estimated and actual in tons.
5. Quantity of waste recycled, both estimated and actual in tons.
6. Total quantity of waste recovered (salvaged plus recycled) in tons.
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.5 QUALITY ASSURANCE

A. Waste Management Coordination shall be the responsibility of the general construction contractor.

1.6 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

B. Waste Management Coordinator: The general contractor shall act as the waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.

C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

1. Distribute waste management plan to everyone concerned within three days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

A. Comply with requirements in Section 024119 "Selective Demolition" for salvaging demolition waste.

B. Salvaged Items for Reuse in the Work:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until installation.
4. Protect items from damage during transport and storage.
5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

C. Salvaged Items for Sale and Donation: Not permitted on Project site.

D. Salvaged Items for Owner's Use:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.4 RECYCLING DEMOLITION WASTE

A. Asphalt Paving: Grind asphalt to maximum 1-1/2-inch size.

B. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.

C. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.

1. Pulverize concrete to maximum 1-1/2-inch size.

D. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.

E. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. General: Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Owner's property.

C. Burning: Do not burn waste materials.

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.

B. Related Requirements:

1. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
2. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
3. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.3 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest-control inspection.

1.4 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Engineer. Label with manufacturer's name and model number.
5. Submit testing, adjusting, and balancing records.
6. Submit sustainable design submittals not previously submitted.
7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Owner of changeover in utility services.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements.
10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Engineer, that must be completed or corrected before certificate will be issued.

1.5 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

1. Submit a final Application for Payment.
2. Certified List of Incomplete Items: Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1.6 LIST OF INCOMPLETE ITEMS

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor, listed by room or space number.
2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

    a. Project name.
    b. Date.
    c. Name of Engineer.
    d. Name of Contractor.
    e. Page number.

4. Submit list of incomplete items in the following format:
    a. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).

1.7 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Engineer for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

C. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

1. Submit on digital media acceptable to Engineer by uploading to web-based project software site when available, or by email to Engineer.

D. Warranties in Paper Form:

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.

E. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
b. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural

weathering of exterior surfaces. Restore reflective surfaces to their original condition.

c. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
d. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
e. Vacuum and mop concrete.
f. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
g. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
h. Remove labels that are not permanent.
i. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
j. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
k. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
l. Clean ducts, blowers, and coils.

m. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
n. Clean strainers.
o. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.

D. Construction Waste Disposal: Comply with waste-disposal requirements in Section 015000 "Temporary Facilities and Controls" and/or Section 017419 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations required by Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory manuals.
2. Emergency manuals.
3. Systems and equipment operation manuals.
4. Systems and equipment maintenance manuals.
5. Product maintenance manuals.

1.2 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Engineer and Owner will comment on whether content of operation and maintenance submittals is acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operation and maintenance manuals in the following format:

1. Submit by uploading to web-based project software site. Enable reviewer comments on draft submittals.
2. Submit two (2) paper copies.

C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 2 weeks before commencing demonstration and training. Engineer and Owner will return copy with comments.

1. Correct or revise each manual to comply with Engineer and Owner’s comments. Submit copies of each corrected manual within 15 days of receipt of Engineer and Owner’s comments and prior to commencing demonstration and training.

D. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.3 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
2. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

    a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.4 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Engineer.
7. Names and contact information for major consultants to the Engineer that designed the systems contained in the manuals.

8. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.5 EMERGENCY MANUALS

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

E. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.

5. Special operating instructions and procedures.

1.6 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.7 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds, as described below.

C. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

    a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

H. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1.8 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record specifications.
3. Record Product Data.

B. Related Requirements:

1. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.2 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:
1. Number of Copies: Submit copies of Record Drawings as follows:

a. Initial Submittal:
1) Submit Record Digital Data Files and one set(s) of plots.
2) Engineer will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

b. Final Submittal:
1) Submit PDF electronic files of scanned Record Prints and three set(s) of file prints.
2) Print each drawing, whether or not changes and additional information were recorded.

c. Final Submittal:
1) Submit Record Digital Data Files and three set(s) of Record Digital Data File plots.
2) Plot each drawing file, whether or not changes and additional information were recorded.

B. Record Specifications: Submit annotated PDF electronic files and 3 paper copies of Project's Specifications, including addenda and Contract modifications.

C. Record Product Data: Submit annotated PDF electronic files and directories and 3 paper copies of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

1.3 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
b. Accurately record information in an acceptable drawing technique.
c. Record data as soon as possible after obtaining it.
d. Record and check the markup before enclosing concealed installations.
e. Cross-reference record prints to corresponding photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to Drawings.
b. Revisions to details shown on Drawings.
c. Depths of foundations.
d. Locations and depths of underground utilities.
e. Revisions to routing of piping and conduits.
f. Revisions to electrical circuitry.
g. Actual equipment locations.
h. Duct size and routing.
i. Locations of concealed internal utilities.
j. Changes made by Change Order or Construction Change Directive.
k. Changes made following Engineer's written orders.
l. Details not on the original Contract Drawings.
m. Field records for variable and concealed conditions.
n. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Engineer. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Same digital data software program, version, and operating system as for the original Contract Drawings.

2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
3. Refer instances of uncertainty to Engineer for resolution.
4. Engineer will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.

C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:

    a. Project name.
    b. Date.
    c. Designation "PROJECT RECORD DRAWINGS."
    d. Name of Engineer.
    e. Name of Contractor.

1.4 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
5. Note related Change Orders, Record Product Data, and Record Drawings where applicable.

B. Format: Submit record specifications as annotated PDF electronic file and paper copy.

1.5 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.

B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

C. Format: Submit Record Product Data as annotated PDF electronic file and paper copy.

1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.6 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Engineer's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Instruction in operation and maintenance of systems, subsystems, and equipment.
2. Demonstration and training video recordings.

1.2 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

1.3 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.

1. At completion of training, submit complete training manual(s) for Owner's use prepared in same paper and PDF file format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

1.4 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

1.5 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Engineer.

1.6 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

    a. System, subsystem, and equipment descriptions.
    b. Performance and design criteria if Contractor is delegated design responsibility.
    c. Operating standards.
    d. Regulatory requirements.
    e. Equipment function.
    f. Operating characteristics.
    g. Limiting conditions.
    h. Performance curves.

2. Documentation: Review the following items in detail:

    a. Emergency manuals.
    b. Systems and equipment operation manuals.
    c. Systems and equipment maintenance manuals.
    d. Product maintenance manuals.
    e. Project Record Documents.
    f. Identification systems.
    g. Warranties and bonds.
    h. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

    a. Instructions on meaning of warnings, trouble indications, and error messages.
    b. Instructions on stopping.
    c. Shutdown instructions for each type of emergency.

d. Operating instructions for conditions outside of normal operating limits.
e. Sequences for electric or electronic systems.
f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

a. Startup procedures.
b. Equipment or system break-in procedures.
c. Routine and normal operating instructions.
d. Regulation and control procedures.
e. Control sequences.
f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:

a. Alignments.
b. Checking adjustments.
c. Noise and vibration adjustments.
d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

a. Diagnostic instructions.
b. Test and inspection procedures.

7. Maintenance: Include the following:

a. Inspection procedures.
b. Types of cleaning agents to be used and methods of cleaning.
c. List of cleaning agents and methods of cleaning detrimental to product.
d. Procedures for routine cleaning.
e. Procedures for preventive maintenance.
f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:

a. Diagnosis instructions.
b. Repair instructions.
c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
d. Instructions for identifying parts and components.
e. Review of spare parts needed for operation and maintenance.

1.7 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."

B. Set up instructional equipment at instruction location.

1.8 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner, through Engineer, or, through Construction Manager, with at least seven days' advance notice.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.

F. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.9 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. Record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode with vibration reduction technology.

1. Submit video recordings to web-based Project software site.

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.

D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.

E. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 017900

SECTION 024116 - STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of buildings and site improvements.
2. Abandoning in-place or removing below-grade construction.
3. Disconnecting, capping or sealing, and abandoning in-place or removing site utilities.
4. Salvaging items for reuse by Owner.

1.2 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.3 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1.4 INFORMATIONAL SUBMITTALS

A. Engineering Survey: Submit engineering survey of condition of building.

B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

1. Adjacent Buildings: Detail special measures proposed to protect adjacent buildings to remain including means of egress from those buildings.

C. Schedule of building demolition activities with starting and ending dates for each activity.

D. Predemolition photographs or video.

E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician.

1.5 CLOSEOUT SUBMITTALS

A. Inventory of items that have been removed and salvaged.

1.6 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

1.7 FIELD CONDITIONS

A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.

B. Buildings immediately adjacent to demolition area will be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.

1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent occupied buildings.
2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.

    a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.

C. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

1. Before building demolition, Owner will remove the following items:

    a. All equipment, tools, and all other contents

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. On-site storage or sale of removed items or materials is not permitted.

F. Arrange demolition schedule so as not to interfere with Owner's on-site operations or operations of adjacent occupied buildings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

2.2 SOIL MATERIALS

A. Satisfactory Soils: Comply with requirements in Section 310000 "Earthwork."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting demolition operations.

B. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations.

C. Inventory and record the condition of items to be removed and salvaged.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

B. Salvaged Items: Comply with the following:

1. Clean salvaged items of dirt and demolition debris.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to storage area designated by Owner.
5. Protect items from damage during transport and storage.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Utilities to be Disconnected: Locate, identify, disconnect, and seal or cap off utilities serving buildings and structures to be demolished.

1. Owner will arrange to shut off utilities when requested by Contractor.

2. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
3. Cut off pipe or conduit a minimum of 48 inches below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
4. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.4 PROTECTION

A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.

B. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.

C. Existing Utilities to Remain: Maintain utility services to remain and protect from damage during demolition operations. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.

D. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Section 015000 "Temporary Facilities and Controls."

1. Protect adjacent buildings and facilities from damage due to demolition activities.
2. Protect existing site improvements, appurtenances, and landscaping to remain.
3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.

E. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.5 DEMOLITION

A. General: Demolish indicated buildings and site improvements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
2. Maintain fire watch during and for at least a half hour after flame-cutting operations.
3. Maintain adequate ventilation when using cutting torches.
4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed trafficways if required by authorities having jurisdiction.
2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.

C. Explosives: Use of explosives is not permitted.

D. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.

E. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

F. Salvage: Items to be removed and salvaged are indicated on Drawings.

G. Demolish foundation walls and other below-grade construction that are within footprint of new construction and extending 5 feet outside footprint indicated for new construction.

1. Remove below-grade construction, including basements, foundation walls, and footings, completely.

H. Existing Utilities: Demolish existing utilities and below-grade utility structures that are within 5 feet outside footprint indicated for new construction. Abandon utilities outside this area.

I. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with satisfactory soil materials according to backfill requirements in Section 310000 "Earthwork."

J. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

K. Promptly repair damage to adjacent buildings caused by demolition operations.

3.6 CLEANING

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction and recycle or dispose of them according to Section 017419 "Construction Waste Management and Disposal."

B. Do not burn demolished materials.

C. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.

END OF SECTION 024116

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

1.2 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.3 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1.4 INFORMATIONAL SUBMITTALS

A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

B. Schedule of selective demolition activities with starting and ending dates for each activity.

C. Predemolition photographs or video.

1.5 CLOSEOUT SUBMITTALS

A. Inventory of items that have been removed and salvaged.

1.6 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

C. Notify Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials/Structures on Site: Owner has engaged a qualified testing agency to take samples throughout existing buildings and perform tests for hazardous materials. Hazardous materials were present in the structures and can be found in the report included in Exhibit C prepared by Quality Environmental Solutions & Technologies, Inc. as found within this contract.
   1. Contractor is responsible for engaging a qualified abatement contractor.

   2. If suspected hazardous materials are encountered, do not disturb; immediately notify the hazardous material consultant, Owner and Engineer.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

   1. Maintain fire-protection facilities in service during selective demolition operations.

G. Arrange selective demolition schedule so as not to interfere with Owner's operations.

1.7 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

C. Inventory and record the condition of items to be removed and salvaged.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.

    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.3 PROTECTION

A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

C. Remove temporary barricades and protections where hazards no longer exist.

3.4 SELECTIVE DEMOLITION

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
4. Maintain fire watch during and for at least a half hour after flame-cutting operations.
5. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
6. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer/Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 CLEANING

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction. and recycle or dispose of them according to Section 017419 "Construction Waste Management and Disposal."

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

C. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 030130 - MAINTENANCE OF CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removal of deteriorated concrete and subsequent patching.
2. Floor joint repair.
3. Epoxy crack injection.
4. Corrosion-inhibiting treatment.
5. Polymer sealers.

1.2 UNIT PRICES

A. General: Unit prices include the cost of preparing existing construction to receive the work indicated and costs of field quality control required for units of work completed.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: Cured Samples for each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Material certificates.

B. Product test reports.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Concrete-Maintenance Specialist Qualifications: Engage an experienced concrete-maintenance firm that employs installers and supervisors who are trained and approved by manufacturer to apply packaged patching-mortar, crack-injection adhesive , corrosion-inhibiting treatments, and polymer sealers to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing or patching new concrete is insufficient experience for concrete-maintenance work.

B. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Concrete removal and patching.
2. Floor joint repair.
3. Epoxy crack injection.
4. Polymer sealer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: For repair products, obtain each color, grade, finish, type, and variety of product from single source and from single manufacturer with resources to provide products of consistent quality in appearance and physical properties.

2.2 BONDING AGENTS

A. Epoxy-Modified, Cementitious Bonding and Anticorrosion Agent: Manufactured product that consists of water-insensitive epoxy adhesive, portland cement, and water-based solution of corrosion-inhibiting chemicals that forms a protective film on steel reinforcement.

B. Epoxy Bonding Agent: ASTM C881/C881M, bonding system Type V and free of VOCs.

C. Latex Bonding Agent, Redispersible: ASTM C1059/C1059M, Type I for use at nonstructural and interior locations unless otherwise indicated.

D. Latex Bonding Agent, Non-Redispersible: ASTM C1059/C1059M, Type II for use at structural and exterior locations and where indicated.

2.3 PATCHING MORTAR

A. Patching Mortar Requirements:

1. Only use patching mortars that are recommended by manufacturer for each applicable horizontal, vertical, or overhead use orientation.
2. Color and Aggregate Texture: Provide patching mortar and aggregates of colors and sizes necessary to produce patching mortar where indicated that matches existing, adjacent, exposed concrete. Blend several aggregates if necessary to achieve suitable matches.
3. Coarse Aggregate for Patching Mortar: ASTM C33/C33M, washed aggregate, Size No. 8, Class 5S. Add to patching-mortar mix only as permitted by patching-mortar manufacturer.

B. Cementitious Patching Mortar: Packaged, dry mix for repair of concrete.
1. Compressive Strength: Not less than 4000 psi at 28 days when tested according to ASTM C109/C109M.

C. Rapid-Strengthening, Cementitious Patching Mortar: Packaged, dry mix, ASTM C928/C928M for repair of concrete.
1. Compressive Strength: Not less than 3000 psi within three hours when tested according to ASTM C109/C109M.

D. Polymer-Modified, Cementitious Patching Mortar: Packaged, dry mix for repair of concrete and that contains a non-redispersible latex additive as either a dry powder or a separate liquid that is added during mixing.
   1. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C109/C109M.

E. Polymer-Modified, Silica-Fume-Enhanced, Cementitious Patching Mortar: Packaged, dry mix for repair of concrete and that contains silica fume complying with ASTM C1240 and a non-redispersible latex additive as either a dry powder or a separate liquid that is added during mixing.
   1. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C109/C109M.

2.4 JOINT FILLER

A. Epoxy Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A Shore durometer hardness of at least 80 according to ASTM D2240.

B. Polyurea Joint Filler: Two-component, semirigid, 100 percent solids, polyurea resin with a Type A Shore durometer hardness of at least 80 according to ASTM D2240.

C. Color: Matching existing joint filler.

2.5 EPOXY CRACK-INJECTION MATERIALS

A. Epoxy Crack-Injection Adhesive: ASTM C881/C881M, bonding system Type IV at structural locations and where indicated, Type I at other locations; free of VOCs.
   1. Capping Adhesive: Product manufactured for use with crack-injection adhesive by same manufacturer.

2.6 CORROSION-INHIBITING MATERIALS

A. Corrosion-Inhibiting Treatment: Waterborne solution of alkaline corrosion-inhibiting chemicals for concrete-surface application that penetrates concrete by diffusion and forms a protective film on steel reinforcement.

2.7 POLYMER-SEALER MATERIALS

A. Epoxy Polymer Sealer: Low-viscosity epoxy, penetrating sealer and crack filler recommended by manufacturer for penetrating and sealing cracks in exterior concrete traffic surfaces; VOC content 400 g/L or less.

B. Methacrylate Polymer Sealer: Low-viscosity, high-molecular-weight methacrylate**,** penetrating sealer and crack filler recommended by manufacturer for penetrating and sealing cracks in exterior concrete traffic surfaces; VOC content 400 g/L or less.
   1. Color: As indicated by manufacturer's designations As selected by Architect from full range of industry colors.

2.8 MISCELLANEOUS MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I, II, or III unless otherwise indicated.

B. Water: Potable.

2.9 MIXES

A. General: Mix products, in clean containers, according to manufacturer's written instructions.

B. Dry-Pack Mortar: Mix required type(s) of patching-mortar dry ingredients with just enough liquid to form damp cohesive mixture that can be squeezed by hand into a ball but is not plastic.

PART 3 - EXECUTION

3.1 CONCRETE MAINTENANCE

A. Have concrete-maintenance work performed only by qualified concrete-maintenance specialist.

B. Comply with manufacturers' written instructions for surface preparation and product application.

3.2 EXAMINATION

A. Notify Engineer seven days in advance of dates when areas of deteriorated or delaminated concrete and deteriorated reinforcing bars will be located.

B. Locate areas of deteriorated or delaminated concrete using hammer or chain-drag sounding and mark boundaries. Mark areas for removal by simplifying and squaring off boundaries. At columns and walls make boundaries level and plumb unless otherwise indicated.

C. Pachometer Testing: Locate at least three reinforcing bars using a pachometer, and drill test holes to determine depth of cover. Calibrate pachometer using depth of cover measurements, and verify depth of cover in removal areas using pachometer.

D. Perform surveys as the Work progresses to detect hazards resulting from concrete-maintenance work.

3.3 PREPARATION

A. Ensure that supervisory personnel are on-site and on duty when concrete maintenance work begins and during its progress.

B. Protect persons, motor vehicles, surrounding surfaces of building being repaired, building site, plants, and surrounding buildings from harm resulting from concrete maintenance work.

1. Comply with each product manufacturer's written instructions for protections and precautions.
2. Contain dust and debris generated by concrete maintenance work and prevent it from reaching the public or adjacent surfaces.
3. Protect floors and other surfaces along haul routes from damage, wear, and staining.
4. Provide supplemental sound-control treatment to isolate removal and dismantling work from other areas of the building.
5. Neutralize and collect alkaline and acid wastes for disposal off Owner's property.

C. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Engineer immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is in working order.

1. Prevent solids such as aggregate or mortar residue from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from concrete maintenance work.
2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.

D. Preparation for Concrete Removal: Make explorations, probes, and inquiries as necessary to determine condition of construction to be removed in the course of repair.

1. Verify that affected utilities have been disconnected and capped.
2. Provide and maintain shoring, bracing, and temporary structural supports as required to preserve stability and prevent unexpected or uncontrolled movement, settlement, or collapse of construction being demolished and construction and finishes to remain. Strengthen or add new supports when required during progress of removal work.

E. Reinforcing-Bar Preparation: Remove loose and flaking rust from exposed reinforcing bars by high-pressure water cleaning, abrasive blast cleaning, needle scaling, or wire brushing until only tightly adhered light rust remains.

1. Where section loss of reinforcing bar is more than 25 percent, or 20 percent in two or more adjacent bars, cut bars and remove and replace as indicated on Drawings.
2. Remove additional concrete as necessary to provide at least 3/4-inch clearance at existing and replacement bars.
3. Splice replacement bars to existing bars according to ACI 318 by lapping, welding, or using mechanical couplings.

F. Preparation of Floor Joints for Repair: Saw-cut joints full width to edges and depth of spalls, but not less than 2 inches deep. Clean out debris and loose concrete; vacuum or blow clear with compressed air.

3.4 REMOVAL OF CONCRETE

A. Do not overload structural elements with debris.

B. Saw-cut perimeter of areas indicated for removal to a depth of at least 1/2 inch. Make cuts perpendicular to concrete surfaces and no deeper than cover on reinforcement.

C. Remove deteriorated and delaminated concrete by breaking up and dislodging from reinforcement.

D. Remove additional concrete as directed on the project plans.

E. Where half or more of the perimeter of reinforcing bar is exposed, bond between reinforcing bar and surrounding concrete is broken, or reinforcing bar is corroded, remove concrete from entire perimeter of bar and to provide at least 3/4-inch clearance around bar.

F. Test areas where concrete has been removed by tapping with hammer, and remove additional concrete until unsound and disbonded concrete is completely removed.

G. Provide surfaces with a fractured profile of at least 1/8 inch that are approximately perpendicular or parallel to original concrete surfaces. At columns and walls, make top and bottom surfaces level unless otherwise directed.

H. Thoroughly clean removal areas of loose concrete, dust, and debris.

3.5 APPLICATION OF BONDING AGENT

A. Epoxy-Modified, Cementitious Bonding and Anticorrosion Agent: Apply to reinforcing bars and concrete . Apply to reinforcing bars in two coats, allowing first coat to dry two to three hours before applying second coat. Allow to dry before placing patching mortar.

B. Epoxy Bonding Agent: Apply to reinforcing bars and concrete, leaving no pinholes or other uncoated areas. Apply to reinforcing bars in at least two coats, allowing first coat to dry before applying second coat. Place patching mortar while epoxy is still tacky. If epoxy dries, recoat before placing patching mortar.

C. Latex Bonding Agent, Type I: Apply to concrete by brush roller or spray. Allow to dry before placing patching mortar.

D. Latex Bonding Agent, Type II: Mix with portland cement and scrub into concrete surface. Place patching mortar while bonding agent is still wet. If bonding agent dries, recoat before placing patching mortar.

E. Slurry Coat for Cementitious Patching Mortar: Wet substrate thoroughly and then remove standing water. Scrub a slurry of neat patching mortar into substrate, filling pores and voids.

3.6 INSTALLATION OF PATCHING MORTAR

A. Place patching mortar as specified in this article unless otherwise recommended in writing by manufacturer or where dry-pack mortar is indicated.

1. Provide forms where necessary to confine patch to required shape.
2. Wet substrate and forms thoroughly and then remove standing water.

B. Pretreatment: Apply specified bonding agent.

C. General Placement: Place patching mortar by troweling toward edges of patch to force intimate contact with edge surfaces. For large patches, fill edges first and then work toward center, always troweling toward edges of patch. At fully exposed reinforcing bars, force patching mortar to fill space behind bars by compacting with trowel from sides of bars.

D. Vertical Patching: Place material in lifts of not more than thickness recommended by manufacturer. Do not feather edge.

E. Overhead Patching: Place material in lifts of not more than thickness recommended by manufacturer. Do not feather edge.

F. Consolidation: After each lift is placed, consolidate material and screed surface.

G. Multiple Lifts: Where multiple lifts are used, score surface of lifts to provide a rough surface for placing subsequent lifts. Allow each lift to reach final set before placing subsequent lifts.

H. Finishing: Allow surfaces of lifts that are to remain exposed to become firm and then finish to a smooth surface with a wood or sponge float.

I. Curing: Wet-cure cementitious patching materials, including polymer-modified cementitious patching materials, for not less than seven days by water-fog spray or water-saturated absorptive cover.

3.7 INSTALLATION OF DRY-PACK-MORTAR

A. Use dry-pack mortar for deep cavities and where indicated. Place as specified in this article unless otherwise recommended in writing by manufacturer.

1. Provide forms where necessary to confine patch to required shape.
2. Wet substrate and forms thoroughly and then remove standing water.

B. Pretreatment: Apply specified bonding agent.

C. Place dry-pack mortar into cavity by hand, and compact tightly into place. Do not place more material at a time than can be properly compacted. Continue placing and compacting until patch is approximately level with surrounding surface.

D. After cavity is filled and patch is compacted, trowel surface to match profile and finish of surrounding concrete.

E. Wet-cure patch for not less than seven days by water-fog spray or water-saturated absorptive cover.

3.8 FLOOR-JOINT REPAIR

A. Cut out deteriorated concrete and reconstruct sides of joint with patching mortar as indicated on Drawings. Install joint filler in nonmoving floor joints where indicated and as specified in this article.

B. Depth: Install joint filler to a depth of at least 2 inches. Use fine silica sand no more than 1/4 inch deep to close base of joint. Do not use sealant backer rods or compressible fillers below joint filler.

C. Top Surface: Install joint filler so that when cured, it is flush at top surface of adjacent concrete. If necessary, overfill joint and remove excess when filler has cured.

3.9 EPOXY CRACK INJECTION

A. Clean cracks with oil-free compressed air or low-pressure water to remove loose particles.

B. Clean areas to receive capping adhesive of oil, dirt, and other substances that would interfere with bond.

C. Place injection ports as recommended by epoxy manufacturer, spacing no farther apart than thickness of member being injected. Seal injection ports in place with capping adhesive.

D. Seal cracks at exposed surfaces with a ribbon of capping adhesive at least 1/4 inch thick by 1 inch wider than crack.

E. Inject cracks wider than 0.003 inch to a depth of 8 inches.

F. Inject epoxy adhesive, beginning at widest part of crack and working toward narrower parts. Inject adhesive into ports to refusal, capping adjacent ports when they extrude epoxy. Cap injected ports and inject through adjacent ports until crack is filled.

G. After epoxy adhesive has set, remove injection ports and grind surfaces smooth.

3.10 APPLICATION OF CORROSION-INHIBITING-TREATMENT

A. Apply corrosion-inhibiting treatment to surfaces indicated on Drawings, from wall-to-wall or curb-to-curb and from joint-to-joint in the perpendicular direction.

B. Apply by brush, roller, or airless spray in two coats at manufacturer's recommended application rate. Remove film of excess treatment before patching treated concrete or applying a sealer.

3.11 APPLICATION OF POLYMER SEALER

A. Apply polymer sealer by brush, roller, or airless spray at manufacturer's recommended application rate.

B. Apply to traffic-bearing surfaces, including parking areas and walks.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:

1. Packaged, Cementitious Patching Mortar: Four (4) randomly selected sets of samples for each type of mortar required, tested according to ASTM C928/C928M.
2. Joint Filler: Core-drilled samples to verify proper installation.

    a. Testing Frequency: One sample for each 100 feet of joint filled.
    b. Where samples are taken, refill holes with joint filler.

3. Epoxy Crack Injection: Core-drilled samples to verify proper installation.

    a. Testing Frequency: Three samples from mockup and one sample for each 100 feet of crack injected.
    b. Where samples are taken, refill holes with epoxy mortar.

C. Product will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 030130

SECTION 031000 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Form-facing material for cast-in-place concrete.
2. Shoring, bracing, and anchoring.

1.2 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each of the following:

1. Exposed surface form-facing material.
2. Concealed surface form-facing material.
3. Form ties.
4. Waterstops.
5. Form-release agent.

B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.

1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301.

a. Location of construction joints is subject to approval of the Engineer.

3. Indicate location of waterstops.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Minutes of pre-installation conference.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.

1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
2. Design formwork to limit deflection of form-facing material to L/240 of center-to-center spacing of supports.

    a. For architectural concrete specified within the project plans, limit deflection of form-facing material, studs, and walers to 0.0025 times their respective clear spans (L/400).

2.2 FORM-FACING MATERIALS

A. As-Cast Surface Form-Facing Material:

1. Provide continuous, true, and smooth concrete surfaces.
2. Furnish in largest practicable sizes to minimize number of joints.
3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete, and as follows:

    a. Plywood, metal, or other approved panel materials.
    b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

        1) APA HDO (high-density overlay).
        2) APA MDO (medium-density overlay); mill-release agent treated and edge sealed.
        3) APA Structural 1 Plyform, B-B or better; mill oiled and edge sealed.
        4) APA Plyform Class I, B-B or better; mill oiled and edge sealed.

B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.

1. Provide lumber dressed on at least two edges and one side for tight fit.

2.3 WATERSTOPS

A. Flexible PVC Waterstops: U.S. Army Corps of Engineers CRD-C 572, for embedding in concrete to prevent passage of fluids through joints, with factory fabricate corners, intersections, and directional changes.

1. Profile: Ribbed with center bulb.

2. Dimensions: 6 inches by 3/8 inch thick; nontapered; unless otherwise noted on the plans.

B. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

C. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.

2.4 RELATED MATERIALS

A. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

C. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

D. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
2. Form release agent for form liners shall be acceptable to form liner manufacturer.

E. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

A. Comply with ACI 301.

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes.

C. Limit concrete surface irregularities as follows:

1. Surface Finish-3.0: ACI 117 Class A, 1/8 inch.

D. Construct forms tight enough to prevent loss of concrete mortar.

1. Minimize joints.
2. Exposed Concrete: Symmetrically align joints in forms.

E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.

1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
3. Install keyways, reglets, recesses, and other accessories, for easy removal.

F. Do not use rust-stained, steel, form-facing material.

G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.

1. Provide and secure units to support screed strips.
2. Use strike-off templates or compacting-type screeds.

H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.

1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
2. Locate temporary openings in forms at inconspicuous locations.

I. Chamfer exterior corners and edges of permanently exposed concrete.

J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.

K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.

1. Determine sizes and locations from trades providing such items.
2. Obtain written approval of Engineer prior to forming openings not indicated on Drawings.

L. Construction and Movement Joints:

1. Construct joints true to line with faces perpendicular to surface plane of concrete.
2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
3. Place joints perpendicular to main reinforcement.
4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.

    a. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
6. Space vertical joints in walls as specified in Section 033000 "Cast-In-Place Concrete.".

a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.

1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.

N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
4. Install dovetail anchor slots in concrete structures, as indicated on Drawings.
5. Clean embedded items immediately prior to concrete placement.

3.3 INSTALLATION OF WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.

1. Install in longest lengths practicable.
2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 033000 "Cast-In-Place Concrete."
4. Secure waterstops in correct position at 12 inches on center.
5. Field fabricate joints in accordance with manufacturer's instructions using heat welding.

a. Miter corners, intersections, and directional changes in waterstops.
b. Align center bulbs.

6. Clean waterstops immediately prior to placement of concrete.
7. Support and protect exposed waterstops during progress of the Work.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.

1. Install in longest lengths practicable.
2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
3. Protect exposed waterstops during progress of the Work.

3.4 SHORING AND RESHORING INSTALLATION

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

1. Where Special Inspections are required and listed on the plans, the owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
2. Where Special Inspections are not required, the contractor shall engage a qualified testing and inspecting agency, at contractor’s expense, to perform tests and inspections and to submit reports as outlined in section 3.12.B of Section 033000 "Cast-In-Place Concrete”.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.
2. Inspect insulating concrete forms for shape, location, and dimensions of the concrete member being formed.

END OF SECTION 031000

SECTION 032000 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel reinforcement bars.
2. Welded-wire reinforcement.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.
2. Bar supports.
3. Mechanical splice couplers.

B. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.

1. Location of construction joints is subject to approval of the Engineer.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1. Reinforcement to Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M

B. Material Certificates: For each of the following, signed by manufacturers:

1. Epoxy-Coated Reinforcement: CRSI's "Epoxy Coating Plant Certification."

C. Material Test Reports: For the following, from a qualified testing agency:

1. Steel Reinforcement:

a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.

2. Mechanical splice couplers.

D. Field quality-control reports.

E. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

B. Epoxy-Coated Reinforcing Bars:

1. Steel Bars: ASTM A615/A615M, Grade 60, deformed bars.
2. Epoxy Coating: ASTM A775/A775M or ASTM A934/A934M with less than 2 percent damaged coating in each 12-inch bar length.

C. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

D. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

E. Galvanized-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from galvanized-steel wire into flat sheets.

F. Epoxy-Coated Welded-Wire Reinforcement: ASTM A884/A884M, Class A coated, Type 1, deformed steel.

2.2 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.

1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

    a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
    b. For epoxy-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.
    c. For dual-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.
    d. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.
    e. For stainless steel reinforcement, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

B. Mechanical Splice Couplers: ACI 318 Type 1, same material of reinforcing bar being spliced.

C. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.

2.3 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection of In-Place Conditions:

1. Do not cut or puncture vapor retarder.
2. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

B. Accurately position, support, and secure reinforcement against displacement.

1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
2. Do not tack weld crossing reinforcing bars.

C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

D. Unless otherwise indicated on drawings, provide 2” of concrete cover for all reinforcing steel when cast against forms, or 3” of concrete cover for all reinforcing steel when cast against earth.

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Splices: Lap splices and development lengths as indicated on Drawings.

1. Lap splices and rebar development lengths in accordance with ACI 318.
2. Stagger splices in accordance with ACI 318.
3. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.

G. Install welded-wire reinforcement in longest practicable lengths.

1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."

a. For reinforcement less than W4.0 or D4.0, continuous support spacing shall not exceed 12 inches.

2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
4. Lace overlaps with wire.

3.3 JOINTS

A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.

1. Place joints perpendicular to main reinforcement.
2. Continue reinforcement across construction joints unless otherwise indicated.
3. Do not continue reinforcement through sides of strip placements of floors and slabs.

3.4 INSTALLATION TOLERANCES

A. Comply with ACI 117.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

1. Where Special Inspections are required and listed on the plans, the owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
2. Where Special Inspections are not required, the contractor shall engage a qualified testing and inspecting agency, at contractor’s expense, to perform tests and inspections and to submit reports as outlined in section 3.12.B in Section 033000 "Cast-In-Place Concrete”.

B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Steel-reinforcement placement.
2. Steel-reinforcement mechanical splice couplers.
3. Steel-reinforcement welding.

END OF SECTION 032000

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 031000 “Concrete Forming and Accessories” for form-facing materials, form liner, insulating concrete forms, and waterstops.
2. Section 032000 “Concrete Reinforcing” for steel reinforcing bars and welded-sire reinforcement.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, and other pozzolans materials subject to compliance with requirements.

B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments. Include the following:

1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Durability exposure class.
4. Maximum w/cm.
5. Calculated equilibrium unit weight, for lightweight concrete.
6. Slump limit.
7. Air content.
8. Nominal maximum aggregate size.

9. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
10. Intended placement method.

C. Preconstruction Testing: Concrete mixture design submissions shall include laboratory trial testing data for each concrete mixture.

1. Include the following information in each test report:

a. Admixture dosage rates.
b. Slump.
c. Air content.
d. Seven-day compressive strength.
e. 28-day compressive strength.

D. Cold Weather Submittals

1. In addition to the requirements of 1.4.B, contractor shall submit alternate design mixtures for use during cold weather periods.
2. Concrete Temperature Log: Contractor shall record and maintain a log of the concrete temperature for the duration of the cold weather protection period.
   a. Temperature readings should be recorded on an hourly basis during work hours and every 3 hours during non-work hours.
   b. This log should be kept on the job site and be always accessible to inspection personnel during work hours.
   c. The temperature log shall be submitted to the engineer for inclusion in project records upon completion of the monitoring period.

E. Shop Drawings:

1. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Indicate bar sizes, lengths, material, grade, bar schedule, stirrups spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

2. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

a. Location of construction joints is subject to approval of the Engineer.

F. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:

1. Concrete Class designation.
2. Location within Project.
3. Exposure Class designation.
4. Formed Surface Finish designation and final finish.
5. Final finish for floors.
6. Curing process.
7. Floor treatment if any.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Curing compounds.
4. Floor and slab treatments.
5. Bonding agents.
6. Adhesives.
7. Vapor retarders.
8. Joint-filler strips.
9. Repair materials.

B. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

C. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

D. Field quality-control reports.

E. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products that complies with ASTM C94 requirements for production facilities and equipment.

1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. Source Limitations: Obtain each type or class of cementitious material from the same brand from the same manufacturer’s plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4, “Structural Welding Code – Reinforcing Steel.”

D. Mockups: Full-size physical assemblies that are constructed on-site either as freestanding temporary built elements or as part of permanent construction. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. Laboratory Mockups: Full-size physical assemblies constructed and tested at testing facility to verify performance characteristics.

2. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as freestanding temporary built elements or as indicated in-place portions of permanent construction if approved by Engineer, consisting of multiple products, assemblies, and subassemblies, with cutaways enabling inspection of concealed portions of the Work.

    a. Include each system, assembly, component, and part of the exterior wall and roof to be constructed for the Project. Colors of components shall be those selected by the Engineer for use in the Project.

3. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes; doors; windows; millwork; casework; specialties; furnishings and equipment; and lighting.

4. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.

5. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.

E. Mockups for SF-2.0 are not required unless opted otherwise. Mockups for SF-3.0 are required.

F. Pre-Installation Conference for Concrete Construction: Pre-installation conference shall be required on any project that contains 100 cu. yds. or more of concrete.

1. Contractor shall be responsible for planning and coordination of meeting agenda and notification of participants. The meeting shall be scheduled prior to the first scheduled concrete pour for the project.

2. Personnel to Attend: Contractor's project manager, owner's representative, concrete subcontractor, architect, engineer, testing lab supervisor, pumping contractor, concrete producer's quality control director, inspection agency personnel, and construction manager, if applicable, and anyone else with the need to know.

3. Suggested Agenda Items shall include but are not limited to: Project Information and Participants, Construction Sequence and Process, Base/Subbase preparation and acceptance, Site Access, Formwork and Removal, Placing Concrete – equipment and procedures, Consolidation, Finishing, Jointing, Curing and Sealing, Protection of Concrete, Hot and Cold Weather precautions, QA/QC, Inspection and Testing, Special Inspections, etc.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301.

B. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

C. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil and other contaminants.

1.8 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

A. Cementitious Materials:

1. Portland Cement: ASTM C150, Type I/II, gray.
2. Fly Ash: ASTM C618, Class C or F.
3. Slag Cement: ASTM C989, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size:

Sieve Size	% Passing by Weight
2½”	-
2"	-
1½”	100
1"	93-100
½”	27- 58
¼”	0-8

2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

Sieve Size	% Passing by Weight
3/8”	100
No. 4	90-100
8	75-100
16	50-85
30	25-60
50	10-30
100	1-10
200	0-3

C. Lightweight Aggregate: ASTM C330, 3/4-inch nominal maximum aggregate size.

D. Air-Entraining Admixture: ASTM C260.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture (WRA): ASTM C494, Type A.
2. Mid-Range, Water-Reducing Admixture (MWRA): ASTM C494, Type A
3. High-Range, Water-Reducing Admixture (HRWRA): ASTM C494, Type F.
4. Water-Reducing and Retarding Admixture: ASTM C494, Type B and D.
5. Non-Corrosive, Non-Chloride Accelerator: ASTM C494, Type C or E
6. High-Range, Water-Reducing and Retarding Admixture: ASTM C494, Type G.
7. Plasticizing and Retarding Admixture: ASTM C1017, Type II.

F. Water and Water Used to Make Ice: ASTM C94, potable.

G. Waterproofing Admixture: For use as indicated on the project plans.

1. Xypex Chemical Corporation: XYPEX BIO-SAN G-500.

2.3 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E1745, Class A; not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

1. Provide 15 mil thick vapor retarder subjected to traffic from ready-mixed concrete trucks, concrete buggies, or laser screeds.
2. Provide 20 mil thick vapor retarder where slab will be covered by moisture sensitive flooring.
3. Pipe boots: Construct pipe boots from vapor barrier membrane and seam tape.

2.4 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. BASF Corporation.
b. Euclid Chemical Company (The); an RPM company.

2.5 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

B. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. ChemMasters.
   b. Dayton Superior.
   c. Euclid Chemical Company (The), an RPM company.
   d. L&M Construction Chemicals, Inc.
   e. Meadows, W. R., Inc.
   f. Sika Corporation.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.

1. Color:

   a. Ambient Temperature Below 50 deg F: Black.
   b. Ambient Temperature between 50 deg F and 85 deg F: Any color.
   c. Ambient Temperature Above 85 deg F: White.

D. Curing Paper: Eight-feet-wide paper, consisting of two layers of fibered kraft paper laminated with double coating of asphalt.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Fortifiber Building Systems Group.

E. Water: ASTM C94, Potable.

F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating certified by curing compound manufacturer to not interfere with bonding of floor covering.

H. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A, minimum 25 percent total solids.

I. Clear, Non-yellowing, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A, minimum 25 percent total solids.

J. Concrete Floor Cleaner and Stripper:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    a. Burke by Edoco.
    b. Dayton Superior Corporation.
    c. Euclid Chemical Company.
    d. Kaufman Products, Inc.
    e. L&M Construction Chemicals, Inc.

K. Penetrating Liquid Densifier and Sealer: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    a. Burke by Edoco.
    b. Dayton Superior Corporation.
    c. Euclid Chemical Company.
    d. Kaufman Products, Inc.
    e. L&M Construction Chemicals, Inc.

2.6 RELATED MATERIALS

A. Expansion and Isolation Joint Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.

B. Bonding Agent:
1. Non-load bearing fresh-hard: ASTM C881, Type II, Grade 2 for horizontal and Grade 3 for vertical surfaces.
    a. Class: Provide appropriate class for installation surface temperature.
2. Load bearing Fresh-hard: ASTM C881, Type V, Grade 2 for horizontal and Grade 3 for vertical surfaces.
    a. Class: Provide appropriate class for installation surface temperature.

C. Floor Slab Protective Covering: Eight-feet-wide cellulose fabric.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. McTech Group, Inc.; EZcover.

2.7 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.

2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4000 psi at 28 days when tested according to ASTM C 109.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109.

2.8 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.

1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash or Other Pozzolans: 25 percent by mass.
2. Slag Cement: 50 percent by mass.
3. Total of Fly Ash or Other Pozzolans, Slag Cement: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass.
4. Total of Fly Ash or Other Pozzolans: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.

D. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

1. Use water-reducing, high-range water reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious ratio below 0.50.

2.9 CONCRETE MIXTURES

A. Class A: Structural Normal-weight concrete used for footings, foundation walls and piers, grade beams, and tie beams, not exposed or above grade.

1. Exposure Class: ACI 318 F1.
2. Minimum Compressive Strength: 4000 psi at 28 days.
3. Maximum w/cm: 0.50.
4. Slump Limit: 4 inches, ±1 inch without water reducing admixtures; 5 inches, ±1 inch after addition of WRA or MWRA.
5. Air Content: 5.0 percent, plus or minus 1.5 percent at point of delivery.

B. Class B: Structural Normal-weight concrete used for above grade walls, partially exposed foundation walls and piers, retaining walls, and tank walls.

1. Exposure Class: ACI 318 F2.
2. Minimum Compressive Strength: 4500 psi at 28 days.
3. Maximum w/cm: 0.45.
4. Slump Limit: 4 inches, ±1 inch without water reducing admixtures; 5 inches, ±1 inch after addition of WRA or MWRA.
5. Air Content: 6.0 percent, plus or minus 1.5 percent at point of delivery

C. Class C: Structural Normal-weight concrete used for interior slabs-on-ground.

1. Exposure Class: ACI 318 F0
2. Minimum Compressive Strength: 4000 psi at 28 days.
3. Maximum w/cm: 0.44.
4. Minimum Cementitious Materials Content: 540lb/cu. yd.
5. Slump Limit: 4 inches, ±1 inch without water reducing admixtures; 5 inches, ±1 inch after addition of WRA or MWRA; or 7 inches, ±1 inch after addition of HRWRA.
6. Air Content: No air entrainement.
    a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.

D. Class D: Structural Normal-weight concrete used for exterior slabs, mat foundations, parking garages and concrete paving.
1. Exposure Class: ACI 318 F3
2. Minimum Compressive Strength: 5000 psi at 28 days.
3. Maximum w/cm: 0.42.
4. Minimum Cementitious Materials Content: 564 lb/cu. yd.
5. Slump Limit: 4 inches, ±1 inch without water reducing admixtures, 5 inches, ±1 inch after addition of WRA or MWRA, or 7 inches, ±1 inch after addition of HRWRA.
6. Air Content: 6.0 percent, plus or minus 1.5 percent at point of delivery.

E. Class E: Structural Normal-weight concrete used for interior suspended slabs.

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum w/cm: 0.44.
3. Minimum Cementitious Materials Content: 540 lb/cu. yd.
4. Slump Limit: 4 inches, ±1 inch without water reducing admixtures; 5 inches, ±1 inch after addition of WRA or MWRA; or 7 inches, ±1 inch after addition of HRWRA.

5. Air Content: No air entrainement.
    a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.

F. Class F: Structural lightweight concrete used for interior suspended slabs.

1. Minimum Compressive Strength: 4000 psi at 28 days or as indicated.
2. Calculated Equilibrium Unit Weight: 115 lb/cu. ft., plus or minus 3 lb/cu. ft. as determined by ASTM C567/C567M.
3. Slump Limit: 4 inches, ±1 inch without water reducing admixtures; 5 inches, ±1 inch after addition of WRA or MWRA; or 7 inches, ±1 inch after addition of HRWRA.
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery.

G. Class G: Normal-weight concrete used for interior concrete toppings and overlays.

1. Minimum Compressive Strength: 5000 psi at 28 days.
2. Minimum Cementitious Materials Content: 610 lb/cu. yd.
3. Maximum w/cm: 0.42
4. Slump Limit: 4 inches, ±1 inch without water reducing admixtures; 5 inches, ±1 inch after addition of WRA or MWRA; or 7 inches, ±1 inch after addition of HRWRA.
5. Air Content: No air entrainement.
    a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished toppings.
6. Aggregate for thin toppings and overlays (<2'') shall be 3/8'' nominal.

H. Class H: Normal-weight concrete used for exterior site improvements (aprons, landing, equipment pads, tank pads generator pads, sidewalks, etc.).

1. Minimum Compressive Strength: 3500 psi at 28 days.
2. Maximum w/cm: 0.55.
3. Minimum Cementitious Materials Content: 564 lb/cu. yd.
4. Slump Limit: 4 inches, ±1 inch without water reducing admixtures; 5 inches, ±1 inch after addition of WRA or MWRA
5. Air Content: 6.0 percent, plus or minus 1.5 percent at point of delivery.

2.10 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and furnish batch ticket information.

PART 3 - EXECUTION

3.1 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining Work that are attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.2 INSTALLATION OF VAPOR RETARDER

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.

1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
2. Face laps away from exposed direction of concrete pour.
3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
4. Lap joints 6 inches and seal with manufacturer’s recommended tape.
5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
7. Protect vapor retarder during placement of reinforcement and concrete.

    a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

3.3 JOINTS

A. Construct joints true to line, with faces perpendicular to surface plane of concrete.

B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.

1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Engineer.
2. Place joints perpendicular to main reinforcement.

    a. Continue reinforcement across construction joints unless otherwise indicated.
    b. Do not continue reinforcement through sides of strip placements of floors and slabs.

3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
6. Space vertical joints in walls not more than thirty (30’) feet apart in straight runs, unless otherwise indicated on Drawings. Locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.

C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants are indicated.
2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints:

1. Install dowel bars and support assemblies at joints where indicated on Drawings.
2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

3.4 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.

1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify Engineer and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer in writing, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. If a section cannot be placed continuously, provide construction joints as indicated.
2. Deposit concrete to avoid segregation.
3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.

    a. Do not use vibrators to transport concrete inside forms.
    b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
    c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
    d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Do not place concrete floors and slabs in a checkerboard sequence.
2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Maintain reinforcement in position on chairs during concrete placement.
4. Screed slab surfaces with a straightedge and strike off to correct elevations.
5. Level concrete, cut high areas, and fill low areas.
6. Slope surfaces uniformly to drains where required.
7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
8. Do not further disturb slab surfaces before starting finishing operations.

3.5 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.

    a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
    b. Remove projections larger than 1 inch.
    c. Tie holes do not require patching.
    d. Surface Tolerance: ACI 117 Class D.
    e. Apply to concrete surfaces not exposed to public view.

2. ACI 301Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.

    a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
    b. Remove projections larger than 1/4 inch.
    c. Patch tie holes.
    d. Surface Tolerance: ACI 117 Class B.
    e. Locations: Apply to concrete surfaces exposed to public view.

3. ACI 301 Surface Finish SF-3.0:

    a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
    b. Remove projections larger than 1/8 inch.
    c. Patch tie holes.
    d. Surface Tolerance: ACI 117 Class A.
    e. Locations: Apply to concrete surfaces to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

B. Rubbed Finishes: Remove forms as early as permitted by Article 3.9 Removal of Forms and perform necessary repairs and patches.
    1. Smooth Rubbed Finish – If specified, produced smooth-rubbed finish no later than the day following form-work removal. Wet the surface and rub it with an abrasive such as carborundum brick until uniform color and texture are produced. If insufficient cement paste can be drawn from the concrete itself by the rubbing process, use a grout made with cementitious materials from the same sources as used for in-place concrete.

    2. Grout-Cleaned Rubbed Finish – If grout-cleaned rubbed finish is specified, begin cleaning operations after contiguous surfaces are completed and accessible. Do not clean surfaces as Work progresses. Wet the surface and, unless otherwise specified, apply grout consisting of 1 part by volume portland cement and 1-1/2 parts of sand meeting the requirements of ASTM C144 or ASTM C404, with sufficient water to produce a consistency of thick paint. Scrub grout into voids and remove excess grout.

    3. Cork-Floated Finish – if cork-floated finish is specified, remove ties, burrs, and fins. Wet the surface and, unless otherwise specified, apply stiff grout of 1 part portland cement and 1 part sand meeting the requirements of ASTM C144 or ASTM C404 to fill voids. Use sufficient water to produce a stiff consistency. Compress grout into voids. Produce the final finish with cork float, using a swirling motion.

C. Final Concrete Finish: Concrete

D. Related Unformed Surfaces:

    1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
    2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.6 FINISHING FLOORS AND SLABS

A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish:

1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch in one direction.
3. Apply scratch finish to surfaces to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
2. Repeat float passes and re-straightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
3. Apply float finish to surfaces to receive trowel finish, to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic, or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
7. Finish and measure surface, so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.

1. Coordinate required final finish with Engineer before application.
2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, pads, and locations indicated on Drawings.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
2. Coordinate required final finish with Engineer before application.

G. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate or aluminum granule finish to concrete stair treads, platforms, ramps as indicated on Drawings.

1. Apply in accordance with manufacturer's written instructions and as follows:

a. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate or aluminum granules over surface in one or two applications.
b. Tamp aggregate flush with surface, but do not force below surface.
c. After broadcasting and tamping, apply float finish.
d. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate or aluminum granules.

3.7 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches high unless otherwise indicated on Drawings and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
3. Minimum Compressive Strength: 4000 psi at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices.

a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
b. Cast anchor-bolt insert into bases.
c. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.

1. Cast-in inserts and accessories, as shown on Drawings.
2. Screed, tamp, and trowel finish concrete surfaces.

3.8 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301 and ACI 306.1 for cold weather protection during curing.
    a. Concrete curing protection period when cold weather concreting is in effect shall be a minimum of 3 days.
2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
3. Maintain moisture loss of no more than 0.2 lb/sq. ft. x h before and during finishing operations.

B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
3. If forms remain during curing period, moist cure after loosening forms.
4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:

    a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
    b. Continuous Sprinkling: Maintain concrete surface continuously wet.
    c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
    d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
    e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.

        1) Recoat areas subject to heavy rainfall within three hours after initial application.
        2) Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:

1. Begin curing immediately after finishing concrete.
2. Interior Concrete Floors:

    a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:

        1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

a) Lap edges and ends of absorptive cover not less than 12-inches.
b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.

a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
b) Cure for not less than seven days.

3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

a) Water.
b) Continuous water-fog spray.

b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:

1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

a) Lap edges and ends of absorptive cover not less than 12 inches.
b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.

a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
b) Cure for not less than seven days.

3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

a) Water.
b) Continuous water-fog spray.

c. Floors to Receive Polished Finish: Contractor has option of the following:

1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

   a) Lap edges and ends of absorptive cover not less than 12 inches.
   b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

   a) Water.
   b) Continuous water-fog spray.

d. Floors to Receive Chemical Stain:

1) As soon as concrete has sufficient set to permit application without marring concrete surface, install curing paper over entire area of floor.
2) Install curing paper square to building lines, without wrinkles, and in a single length without end joints.
3) Butt sides of curing paper tight; do not overlap sides of curing paper.
4) Leave curing paper in place for duration of curing period, but not less than 28 days.

e. Floors to Receive Urethane Flooring:

1) As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
2) Rewet absorptive cover and cover immediately with polyethylene moisture-retaining cover with edges lapped 6 inches and sealed in place.
3) Secure polyethylene moisture-retaining cover in place to prohibit air from circulating under polyethylene moisture-retaining cover.
4) Leave absorptive cover and polyethylene moisture-retaining cover in place for duration of curing period, but not less than 28 days.

f. Floors to Receive Curing Compound:

1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
2) Recoat areas subjected to heavy rainfall within three hours after initial application.
3) Maintain continuity of coating, and repair damage during curing period.
4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

g. Floors to Receive Curing and Sealing Compound:

1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
2) Recoat areas subjected to heavy rainfall within three hours after initial application.
3) Repeat the process 24 hours later and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.9 REMOVAL OF FORMS

A. The forms shall be removed in such a manner as to ensure the complete safety of the structure or improvements.

B. Forms shall not be disturbed until the concrete has sufficiently hardened and acquired sufficient strength to support its own weight and the load upon it.

C. Form removal shall comply with the following schedule:

Structural Element	Atmospheric Temperature	
	Above 60°F	Between 60°F and 40°F
Walls, column and beam sides	3 Days	4 Days
Suspended Slab Bottoms	5 Days	6 Days
Beam and Girder Bottoms	7 Days	10 Days

D. No backfilling or imposing of other forces or loads shall be permitted before the concrete has attained its design strength.

E. After the removal of forms where concrete is exposed to view, the entire surface shall be rubbed to provide a homogeneous surface and defective surfaces shall be repaired and patched to meet the minimum surface finish class specified in section 3.5.

F. Metal ties shall be cut back at least three-quarters (¾") inch and spaces filled. Patches shall be properly cured, color matched, and otherwise treated to obtain as near a permanent homogeneous surface as practicable.

3.10 TOLERANCES

A. Conform to ACI 117.

3.11 APPLICATION OF LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment in accordance with manufacturer's written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Do not apply to concrete that is less than seven days old.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing.
4. Rinse with water; remove excess material until surface is dry.
5. Apply a second coat in a similar manner if the surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller in accordance with manufacturer's written instructions.

3.12 FIELD QUALITY CONTROL

A. Special Inspections:
1. Where Special Inspections are required and listed on the plans, the owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
2. Where Special Inspections are not required, the contractor shall engage a qualified testing and inspecting agency, at contractor's expense, to perform tests and inspections and to submit reports as outlined in section 3.12.B.

B. Testing Agency:

1. Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
2. Testing agency shall immediately report to Engineer, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
3. Testing agency shall report results of tests and inspections, in writing, to Owner, Engineer, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

    a. Test reports shall include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:

        1) Project name.
        2) Name of testing agency.
        3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
        4) Name of concrete manufacturer.
        5) Date and time of inspection, sampling, and field testing.
        6) Date and time of concrete placement.
        7) Location in Work of concrete represented by samples.
        8) Date and time sample was obtained.
        9) Truck and batch ticket numbers.
        10) Design compressive strength at 28 days.
        11) Concrete mixture designation, proportions, and materials.
        12) Field test results.

13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
14) Type of fracture and compressive break strengths at seven days and 28 days.

C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

D. Inspections: Required inspections to be performed by qualified testing agency. Project specific special inspections required are listed on the contract plans.

1. Headed bolts and studs.
2. Verification of use of required design mixture.
3. Concrete placement, including conveying and depositing.
4. Curing procedures and maintenance of curing temperature.
5. Verification of concrete strength before removal of shores and forms from beams and slabs.

E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C172/C172M shall be performed in accordance with the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

2. Slump: ASTM C143/C143M:

a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
b. Perform additional tests when concrete consistency appears to change.

3. Slump Flow: ASTM C1611/C1611M:

a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
b. Perform additional tests when concrete consistency appears to change.

4. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete; ASTM C173/C173M volumetric method, for structural lightweight concrete.

a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

5. Concrete Temperature: ASTM C1064/C1064M:

a. One test hourly when air temperature is above 40 deg F and below or 80 deg F and above, and one test for each composite sample.

6. Unit Weight: ASTM C567/C567M fresh unit weight of structural lightweight concrete.

a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

7. Compression Test Specimens: ASTM C31/C31M:

   a. Cast, initial cure in field for 3 days, then laboratory cure one set of four (4) 6-inch by 12-inch cylinder specimens for each composite sample.
      1) Where maximum coarse aggregate size does not exceed 1¼ inches, five (5) 4-inch by 8-inch cylinder specimens for each composite sample may be cast in-lieu of 6-inch by 12-inch specimens.

8. Compressive-Strength Tests: ASTM C39/C39M.

   a. For each set, test one (1) specimen at seven days, two (2) specimens at 28 days, and hold one (1) specimen in reserve for later testing if required.
      1) Where 4-inch by 8-inch cylinders are cast, test three (3) specimens at 28 days.

9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

10. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspection agency, location of concrete batch in work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for each test performed.

11. Additional Tests:

   a. Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer.
   b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Engineer.

      1) Acceptance criteria for concrete strength shall be in accordance with ACI 301 section 1.6.6.3.

12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

F. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 24 hours of completion of floor finishing and promptly report test results to Engineer.

G. Tightness Testing of Environmental Containment & Water Storage Structures:
   1. Comply with the requirements of ACI 350.1 and this section.
   2. The Contractor shall provide all labor, materials, and devices to seal off pipe openings, in a manner acceptable to the Engineer, for testing the water tightness of the structure.
   3. Structures shall be tested before backfilling and before equipment is installed. Each unit shall be tested separately, and if necessary, shall be bulkheaded from adjacent units. No structure shall be tested until the concrete is at least twenty-eight (28) days old.
   4. Any and all leaks, including, but not limited to those caused by form ties, construction joints, expansion joints, shrinkage cracks, wall embedment, honeycombing, etc. shall be repaired by the Contractor to the satisfaction of the Engineer, and the unit shall be retested until no leaks are present.
   5. All repairs shall be as specified herein, and the cost of all repairs and retesting shall be borne entirely by the contractor at no additional cost to the Owner.
      a. Submit for acceptance the proposed repair methods, materials, and modifications needed to assure that the Work will meet the tightness requirement of Contract Documents.
      b. For Concrete with crystalline waterproofing admixture, consult with admixture manufacturer for recommendations prior to initiating repair work and comply with any manufacturer requirements.
   6. The cost for obtaining the source (supply) for test water required under this work shall be the responsibility of the Contractor and shall conform to requirements of the Owner which may include but are not limited to cross connection control and metering.

3.13 PROTECTION

A. Protect concrete surfaces as follows:

   1. Protect from petroleum stains.
   2. Diaper hydraulic equipment used over concrete surfaces.
   3. Prohibit vehicles from interior concrete slabs.
   4. Prohibit use of pipe-cutting machinery over concrete surfaces.
   5. Prohibit placement of steel items on concrete surfaces.
   6. Prohibit use of acids or acidic detergents over concrete surfaces.
   7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
   8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION 033000

SECTION 033110 - CONTROLLED DENSITY FILL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY:

A. This Section specifies ready-mix Controlled Density Fill (CDF) for the following applications:

1. General backfill applications for over excavated areas below tank structures.

B. Related Sections include the following:

1. Other Division 03 Sections for Concrete related work.
2. Division 31 Sections for Earthwork requirements

C. Definitions:

1. Ready-mix Controlled Density Fill (CDF) is used as an alternative to compacted soil and is also known as Controlled Low Strength Material (CLSM), or flowable fill.

2. Controlled Density Fill shall be hand tool excavatable.

1.3 SUBMITTALS:

A. Submit manufacturer's Stable-Air Generator Admixture product data, installation instructions, and recommendations for material use.

B. Test and Performance Data:

1. Controlled Density Fill shall have a compressive strength of 80 psi according to ASTM C39 at 28 days after placement. Submit complete mix design.
2. Controlled Density Fill shall have a minimal subsidence and bleed water which is measured as a Final Bleeding of less than 2.0% (retains 98.0% of original height after placement, approximately ¼" per foot of depth) as measured in Section 10 of ASTM C940 "Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Pre-placed Aggregate Concrete in the Laboratory".
3. Controlled Density Fill shall have a unit weight of 90 – 125 pcf.

PART 2 - MATERIALS

2.1 PRODUCTS:

A. Air Entraining Admixture:
   1. Grace Construction Products, “DARAFILL”.
   2. Masterbuilders Technologies, “RHEOCELL – RHEOFILL”.
   3. Approved Equal.

B. Portland Cement: Conforming to ASTM C150.

C. Aggregate: Conforming to ASTM C33.

D. Fly Ash: Conforming to ASTM C618, Class C or F.

E. Water: Clean, potable.

2.2 MIXTURE:

A. Mix design shall produce a consistency that will result in a flowable product that is self-leveling and does not require manual means to move it into place at the time of placement. Minimum diameter spread for CFD shall be 8 in.

B. Provide mix with a fresh unit weight between 90 – 125 pcf and a compressive strength of 80 psi when measured 28 days after placement. One year unconfined compressive strength shall not exceed 150 psi.

C. Controlled Density Fill shall have an in-place yield of 98% of the design yield.

D. Entrained air content: 10 - 30%.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine conditions of substrates or other conditions under which the work is to be performed and notify the Engineer of circumstances detrimental to proper placement of the material.

3.2 PLACEMENT:

A. Secure piping, conduits, and other items to be encased to prevent movement during placement of the Controlled Density Fill.

3.3 PROTECTION:

A. Protect Controlled Density Fill from traffic or overlay materials until sufficient strength has been achieved for further construction operations.

END OF SECTION 033113

SECTION 034100 - PRECAST STRUCTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Precast structural concrete.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each precast concrete mixture.

C. Shop Drawings:

1. Include member locations, plans, elevations, dimensions, shapes and sections, openings, support conditions, and types of reinforcement, including special reinforcement.
2. Detail fabrication and installation of precast structural concrete units, including connections at member ends and to adjoining construction.

D. Delegated-Design Submittal: For precast structural concrete indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator, and testing agency.

B. Welding certificates.

C. Material certificates.

D. Material Test Reports: For aggregates.

E. Source quality-control reports.

F. Field quality-control and special inspection reports.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm that assumes responsibility for engineering precast structural concrete units to comply with performance requirements. Responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

1. Designated as a PCI-certified plant as follows:

a. Group C, Category C2 - Prestressed Hollowcore or flat slabs and Repetitively Produced Products.

B. Quality-Control Standard: For manufacturing procedures, testing requirements, and quality-control recommendations for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Precast Concrete Products."

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."

1.6 COORDINATION

A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Design Standards: Comply with ACI 318 and with design recommendations in PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of precast structural concrete units indicated.

B. Structural Performance: Precast structural concrete units and connections shall withstand design loads indicated within limits and under conditions indicated.

1. Fire-Resistance Rating: Select material and minimum thicknesses to provide indicated fire rating.

2.2 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A706/A706M, deformed.

C. Steel Bar Mats: ASTM A184/A184M, fabricated from ASTM A615/A615M, Grade 60 or ASTM A706/A706M, deformed bars, assembled with clips.

D. Plain-Steel Welded Wire Reinforcement: ASTM A1064/A1064M, fabricated from as-drawn steel wire into flat sheets.

E. Deformed-Steel Welded Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

F. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.

2.3 PRESTRESSING TENDONS

A. Strand: ASTM A416/A416M, Grade 270, uncoated, seven-wire, low-relaxation strand.

1. Coat unbonded post-tensioning strand with post-tensioning coating complying with ACI 423.7 and sheath with polypropylene tendon sheathing complying with ACI 423.7. Include anchorage devices and coupler assemblies.

2.4 CONCRETE MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type III, gray, unless otherwise indicated.

B. Supplementary Cementitious Materials:

1. Fly Ash: ASTM C618, Class C or F, with maximum loss on ignition of 3 percent.
2. Metakaolin: ASTM C618, Class N.
3. Silica Fume: ASTM C1240, with optional chemical and physical requirement.
4. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120.
5. Blended Hydraulic Cement: ASTM C595/C595M, Type IS, portland blast-furnace slag or Type IP, portland-pozzolan cement.

C. Normal-Weight Aggregates: Except as modified by PCI MNL 116, ASTM C33/C33M, with coarse aggregates complying with Class 4S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

D. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.

E. Air-Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures.

F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

2.5 STEEL CONNECTION MATERIALS

A. Carbon-Steel Shapes and Plates: ASTM A36/A36M.

B. Carbon-Steel-Headed Studs: ASTM A108, Grade 1010 through 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 116.

C. Carbon-Steel Plate: ASTM A283/A283M, Grade C.

D. Malleable-Iron Castings: ASTM A47/A47M, Grade 32510 or Grade 35028.

E. Carbon-Steel Castings: ASTM A27/A27M, Grade 60-30.

F. High-Strength, Low-Alloy Structural Steel: ASTM A572/A572M.

G. Carbon-Steel Structural Tubing: ASTM A500/A500M, Grade B or Grade C.

H. Wrought Carbon-Steel Bars: ASTM A675/A675M, Grade 65.

I. Deformed-Steel Wire or Bar Anchors: ASTM A496/A496M or ASTM A706/A706M.

J. Carbon-Steel Bolts and Studs: ASTM A307, Grade A; carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A563; and flat, unhardened steel washers, ASTM F844.

K. Zinc-Coated Finish: For exterior steel items, steel in exterior walls, and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A123/A123M or ASTM A153/A153M.

1. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035B or SSPC-Paint 20.

L. Shop-Primed Finish: Prepare surfaces of nongalvanized-steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3, and shop apply lead- and chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79 according to SSPC-PA 1.

2.6 BEARING PADS

A. Provide bearing pads for precast structural concrete units as recommended by precast fabricator for application.

2.7 GROUT MATERIALS

A. Sand-Cement Grout: Portland cement, ASTM C150/C150M, Type I, and clean, natural sand, ASTM C144 or ASTM C404. Mix at ratio of 1 part cement to 2-1/2 to 3 parts sand, by volume, with minimum water required for placement and hydration. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C1218/C1218M.

B. Nonmetallic, Nonshrink Grout: Packaged, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107/C1107M, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-

minute working time. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C1218/C1218M.

C. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C881/C881M, of type, grade, and class to suit requirements.

2.8 INSULATED FLAT-WALL PANEL ACCESSORIES

A. Extruded-Polystyrene Board Insulation: ASTM C578, Type X, 1.30 lb/cu. ft.; ship-lap edges; with thickness of 3 inches.

B. Polyisocyanurate Board Insulation: ASTM C591, Type I, 1.8 lb/cu. ft. unfaced, with thickness of 3 inches.

C. Wythe Connectors: Glass-fiber-reinforced vinylester connectors, Polypropylene pin connectors, Stainless steel pin connectors, Bent galvanized reinforcing bars, Galvanized welded wire trusses, Galvanized bent wire connectors, Epoxy-coated carbon-fiber grid, or Fiberglass trusses manufactured to connect wythes of precast concrete panels.

2.9 CONCRETE MIXTURES

A. Prepare design mixtures for each type of precast concrete required.

B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast structural concrete fabricator's option.

C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 116 when tested according to ASTM C1218/C1218M.

D. Normal-Weight Concrete Mixtures: Proportion face and backup mixtures or full-depth mixtures, at fabricator's option by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 5000 psi.
2. Maximum Water-Cementitious Materials Ratio: 0.45.

E. Water Absorption: Limit water absorption to 6 percent by weight or 14 percent by volume, tested according to ASTM C642, except for boiling requirement.

F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 116.

G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

H. Concrete Mix Adjustments: Concrete mix design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.10 FABRICATION

A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."

B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast structural concrete units to supporting and adjacent construction.

C. Cast-in reglets, slots, holes, and other accessories in precast structural concrete units as indicated on the Contract Drawings.

D. Cast-in openings larger than 10 inches in any dimension. Do not drill or cut openings or prestressing strand without Engineer's approval.

E. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.

F. Reinforce precast structural concrete units to resist handling, transportation, and erection stresses and specified in-place loads.

G. Prestress tendons for precast structural concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 116.

H. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

I. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.

J. Thoroughly consolidate placed concrete by vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 116.

K. Comply with PCI MNL 116 procedures for hot- and cold-weather concrete placement.

L. Identify pickup points of precast structural concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast structural concrete unit on a surface that does not show in finished structure.

M. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.

N. Discard and replace precast structural concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 116 and meet Engineer's approval.

2.11 CASTING INSULATED WALL PANELS

A. Cast, screed, and consolidate wythe supported by mold.

B. Place insulation boards abutting edges and ends of adjacent boards. Insert wythe connectors through insulation, and consolidate concrete around connectors according to connector manufacturer's written instructions.

C. Cast, screed, and consolidate top wythe to meet required finish.

2.12 FABRICATION TOLERANCES

A. Fabricate precast structural concrete units to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL 116 product dimension tolerances as well as position tolerances for cast-in items.

2.13 COMMERCIAL FINISHES

A. Commercial Grade: Remove fins and protrusions larger than 1/8 inch and fill holes larger than 1/2 inch. Rub or grind ragged edges. Faces must have true, well-defined surfaces. Air holes, water marks, and color variations are permitted. Limit form joint offsets to 3/16 inch.

B. Standard Grade: Normal plant-run finish produced in molds that impart a smooth finish to concrete. Surface holes smaller than 1/2 inch caused by air bubbles, normal color variations, form joint marks, and minor chips and spalls are permitted. Fill air holes greater than 1/4 inch in width that occur more than once per 2 sq. in.. Major or unsightly imperfections, honeycombs, or structural defects are not permitted. Limit joint offsets to 1/8 inch.

C. Grade B Finish: Fill air pockets and holes larger than 1/4 inch in diameter with sand-cement paste matching color of adjacent surfaces. Fill air holes greater than 1/8 inch in width that occur more than once per 2 sq. in.. Grind smooth form offsets or fins larger than 1/8 inch. Repair surface blemishes due to holes or dents in molds. Discoloration at form joints is permitted.

D. Grade A Finish: Repair surface blemishes and fill air holes with the exception of air holes 1/16 inch in width or smaller, and form marks where the surface deviation is less than 1/16 inch. Float apply a neat cement-paste coating to exposed surfaces. Rub dried paste coat with burlap to remove loose particles. Discoloration at form joints is permitted. Grind smooth all form joints.

E. Screed or float finish unformed surfaces. Strike off and consolidate concrete with vibrating screeds to a uniform finish. Hand screed at projections. Normal color variations, minor indentations, minor chips, and spalls are permitted. Major imperfections, honeycombing, or defects are not permitted.

F. Smooth, steel trowel finish unformed surfaces. Consolidate concrete, bring to proper level with straightedge, float, and trowel to a smooth, uniform finish.

G. Apply roughened surface finish according to ACI 318 to precast concrete units that receive concrete topping after installation.

2.14 SOURCE QUALITY CONTROL

A. Testing: Test and inspect precast structural concrete according to PCI MNL 116 requirements and ASTM C1610/C1610M, ASTM C1611/C1611M, ASTM C1621/C1621M, and ASTM C1712/C1712M.

B. Defective Units: Discard and replace precast structural concrete units that do not comply with requirements, including strength, manufacturing tolerances, and color and texture range. Chipped, spalled, or cracked units may be repaired, subject to Engineer's approval.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install clips, hangers, bearing pads, and other accessories required for connecting precast structural concrete units to supporting members and backup materials.

B. Erect precast structural concrete level, plumb, and square within specified allowable tolerances. Provide temporary structural framing, shoring, and bracing as required to maintain position, stability, and alignment of units until permanent connections are complete.

1. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
2. Remove projecting lifting devices and use plastic patch caps or sand-cement grout to fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
3. For hollow-core slab voids used as electrical raceways or mechanical ducts, align voids between units and tape butt joint at end of slabs.

C. Connect precast structural concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.

D. Field cutting of precast units is not permitted without approval of Engineer.

E. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed concrete units.

F. Welding: Comply with applicable requirements in AWS D1.1/D1.1M and AWS D1.4/D1.4M for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.

G. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.

H. Grouting or Dry-Packing Connections and Joints: Grout connections and joints and open spaces at keyways, connections, and joints where required or indicated on Shop Drawings. Retain flowable grout in place until hard enough to support itself. Alternatively, pack spaces with stiff dry-pack grout material, tamping until voids are completely filled.

3.2 ERECTION TOLERANCES

A. Erect precast structural concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135.

B. Minimize variations between adjacent slab members by jacking, loading, or other method recommended by fabricator and approved by Engineer.

3.3 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Erection of precast structural concrete members.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Visually inspect field welds and test according to ASTM E165 or to ASTM E709 and ASTM E1444. High-strength bolted connections are subject to inspections.

D. Testing agency will report test results promptly and in writing to Contractor and Engineer.

E. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.

F. Additional testing and inspecting, at Contractor's expense, shall be performed to determine compliance of replaced or additional work with specified requirements.

G. Prepare test and inspection reports.

3.4 REPAIRS

A. Repair precast structural concrete units if permitted by Engineer.

1. Repairs may be permitted if structural adequacy, serviceability, durability, and appearance of units have not been impaired.

B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.

C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A780/A780M.

D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.

E. Remove and replace damaged precast structural concrete units that cannot be repaired or when repairs do not comply with requirements as determined by Engineer.

3.5 CLEANING

A. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.

B. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.

1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's written recommendations. Protect other work from staining or damage due to cleaning operations.
2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 034100

SECTION 034110 – PRESTRESSED HOLLOW-CORE PLANK

PART 1 – GENERAL

1.1 WORK INCLUDED:

A. These specifications cover manufacture, transportation and erection of precast, prestressed, concrete, hollow-core plank, including grouting of joints between adjacent units.

1.2 RELATED WORK:

A. Precast Structural Concrete: Section 034100

B. Concrete Topping: Section 035300

1.3 QUALITY ASSURANCE:

A. Manufacturer Qualifications: The precast concrete manufacturing plant shall be certified by the Prestressed Concrete Institute (PCI) Plant Certification Program prior to the start of production. Manufacturer shall be certified in category C2 and above.
The manufacturer shall retain a registered professional Engineer licensed and registered in NY State to certify that manufacturing is in accordance with design requirements; or the manufacturer shall, at his expense, meet the following requirements:

1. The basis of inspection shall be the Prestressed Concrete Institute's "*Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products*", MNL-116, and the criteria for acceptance shall be the same as the Plant Certification Program.

B. Erector Qualifications: PCI certified and regularly engaged for at least 5 years in the erection of precast structural concrete similar to the requirements of this project.

C. Welder Qualifications: In accordance with AWS D1.1.

D. Testing: In general compliance with applicable provisions of Prestressed Concrete Institute MNL-116, "*Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products*".

E. Requirements of Regulatory Agencies: All local codes plus the following specifications:
   1. ACI 318 – Building Code Requirements for Structural Concrete
   2. AWS D1.1 – Structural Welding Code-Steel

3. AWS D1.4 – Structural Welding Code-Reinforcing Steel
4. ASTM Specifications – As referred to in Part 2-Products, of this Specification

1.4 SUBMITTALS AND DESIGN:

A. Shop Drawings:
   1. Erection Drawings:
      a) Plans locating and defining all hollow-core planks furnished by the manufacturer, with all major openings shown.
      b) Sections and details showing connections, weld plates, edge conditions and support conditions of the hollow-core plank units.
      c) All dead, live and other applicable loads used in the design.
      d) Fire rating.

B. Approvals:

   1. Submit erection drawings for approval prior to fabrication. Fabrication not to proceed prior to receipt of approved drawings.
   2. Alternatively, submit electronic files (ie. PDF) either by email to the GC/CM, or by uploading to internet based project submittal sites.

C. Product Design Criteria:

   1. Loadings for design
      a) Initial handling and erection stresses.
      b) All dead and live loads as specified on the contract plans.
      c) All other loads specified for hollow-core plank where applicable.
   2. Design steel plank support headers when such headers are determined necessary by the manufacturer's engineer.
   3. Design calculations shall be performed by an licensed professional Engineer, registered in the state of New York, and experienced in precast prestressed concrete design. Design calculations to be submitted to the Engineer of Record.
   4. Design shall be in accordance with ACI 318 Building Code Requirements for Structural Concrete and applicable codes.

D. Permissible Design Deviations:

   1. Design deviations will be permitted only after the Architect/Engineer’s written approval of the manufacturer’s proposed design supported by complete design calculations and drawings.
   2. Design deviations shall provide an installation equivalent to the basic intent without incurring additional cost to the owner.

E. Test Reports:

1. Test reports on concrete and other materials shall be submitted upon request.

PART 2 PRODUCTS

2.1 MATERIALS:

A. Hollow-core plank shall be machine cast in 48-inch widths under the trade name **Cella-Core®** as manufactured by Boccella Precast LLC.

B. Manufacturing procedures and tolerances shall be in general compliance with PCI MNL 116

C. Openings: Manufacturer shall engineer the planks for all MEP openings shown on architectural/structural/MEP contract drawings, and coordination plans or BIM models provided by The GC and MEP trades, prior to precast plank shop drawing submittal. Rectangular openings 10” or larger each side can be plant cast-in or field cut. For field cutting, they shall be located by the trade requiring them. Round and small openings (less than 10 inches) shall be drilled, cored drilled or saw cut by the respective trades after grouting. Plank templates will be provided to assist MEP trades locate and avoid coring of precast plank webs and strands. Openings requiring cutting of prestressing strand shall be approved by the precast plank manufacturer before drilling or cutting.

D. Finishes: Bottom surface shall meet PCI MNL 116 Standard Grade finish, and be flat and uniform as resulting from an extrusion process, without major chips, spalls and imperfections. Top surface shall be machine screed and suitable for composite bonding with 2” of structural concrete topping if specified.

E. Patching: Will be acceptable providing the structural adequacy of the hollow core unit is not impaired.

PART 3 EXECUTION

3.1 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Delivery and Handling:

1. Hollow-core plank shall be lifted and supported during manufacturing, stockpiling, transporting and erection operations only at the lifting or supporting points designated by the manufacturer.
2. Transportation, site handling and erection shall be performed by qualified personnel with acceptable equipment and methods.

B. Storage:

1. Store all units off ground on firm, level surfaces with dunnage placed at bearing points.

2. Place stored units so that identification marks are discernible.
3. Separate stacked units by dunnage across full width of each plank.

3.2 ERECTION:

A. Erection and Safety Standards: All field work shall be done in accordance with:
   1. PCI Erector's Manual, MNL-127
   2. PCI Erection Safety for Precast and Prestressed Concrete

B. Site Access: Erection access suitable for cranes and trucks to move unassisted from public roads to all crane working areas as required by erector, or otherwise indicated herein, will be provided and maintained by the general contractor. Obstructing wires shall be shielded or removed and, when applicable, snow removal and winter heat will be provided by the general contractor.

C. Preparation: The general contractor shall be responsible for:
   1. Providing true, level, bearing surfaces on all field-placed bearing walls and other field-placed supporting members. Masonry wall bearing surfaces shall be bond beams with properly filled and cured concrete.

   2. All pipes, stacks, conduits and other such items shall be stubbed off at a level lower than the bearing plane until after the plank are set. Masonry, concrete or steel shall not be installed above plank-bearing surface until after the plank is in place.

D. Installation: Installation of hollow-core slab units shall be performed by the PCI certified erector. Members shall be lifted with slings at points determined by the manufacturer. Bearing strips shall be set where required. Grout keys shall be filled. Openings shall be field cut only after grout has cured, unless authorized by the manufacturer's engineer.

E. Alignment: Members shall be properly aligned. Variations between adjacent members shall be reasonably leveled out by jacking, bolting or any other feasible method as recommended by the manufacturer and the PCI Erector's Manual (MNL-127).
F. Drilling 1/2"Ø to 3/4"Ø weep holes, typically 1'-6" from the ends of the planks and beyond where grouting has flowed into the hollow-cores as required; to allow trapped water to drain out. Sources of trapped water can include rain, snow melt, wet coring and saw cutting, and deck cleaning for topping placement preparation. The general contractor should also look for signs of more trapped water at the lower floors of installed hollow-core plank as trapped water tend to migrate down to the lower floors (darker stained bottom finish and sometimes water droplets are visible). MEP and hung ceiling trades installing their work to the ceiling should also be prepared for unexpected water draining out as they drill into the bottom of the hollow-core plank. It is not recommended to leave trapped water in the plank as that can cause freeze spalls in winter conditions, mold, and damage to paint and other finish materials.

   Patching of weep holes in exposed ceiling areas is required after building is water tight and rooms are heated to a minimum of 40 degrees to provide for proper bonding of patching material."

3.3 FIELD WELDING:

A. Field welding is to be done by AWS certified welders using equipment and materials compatible to the base material.

3.4 ATTACHMENTS AND SMALL HOLES:

A. Subject to approval of the Architect/Engineer, hollow-core plank units may be drilled or “shot” provided no contact is made with the prestressing steel. Round holes and those less than 8 inches on any side shall be drilled or cut by the respective trades. Should spalling occur, it shall be repaired by the trade doing the drilling, shooting or cutting.

3.5 CLEAN UP:

A. Remove rubbish and debris resulting from hollow-core plank work from premises upon completion.

3.6 SAFETY:

A. The general contractor will provide and maintain all safety barricades, rebar caps and opening covers required for plank in accordance with current industry safety standards.

END OF SECTION 034110

SECTION 035300 - CONCRETE TOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Emery-aggregate concrete floor topping.
2. Iron-aggregate concrete floor topping.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 CONCRETE FLOOR TOPPINGS

A. Emery-Aggregate Concrete Floor Topping: Factory-prepared and dry-packaged mixture of graded, crushed emery aggregate containing not less than 50 percent aluminum oxide, not less than 24 percent ferric oxide, and not more than 8 percent silica; portland cement or blended hydraulic cement; plasticizers; and other admixtures to which only water needs to be added at Project site.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Dayton Superior.

2. Compressive Strength (28 Days): 10,000 psi; ASTM C109/C109M.

B. Iron-Aggregate Concrete Floor Topping: Factory-prepared and dry-packaged mixture of graded iron aggregate, portland cement, plasticizers, and other admixtures to which only water needs to be added at Project site.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Euclid Chemical Company (The); an RPM company.

2. Compressive Strength (28 Days): 12,000 psi; ASTM C109/C109M.

2.2 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, 25 percent solids content, minimum.

2.3 RELATED MATERIALS

A. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids epoxy resin with a Type A Shore durometer hardness of 80 or aromatic polyurea with a Type A Shore durometer hardness range of 90 to 95 according to ASTM D2240.

B. Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.

C. Portland Cement: ASTM C150/C150M, Type I or II.

D. Sand: ASTM C404, fine aggregate passing No. 16 sieve.

E. Water: Potable.

F. Acrylic-Bonding Agent: ASTM C1059/C1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

G. Epoxy Adhesive: ASTM C881/C881M, Type V, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements.

2.4 MIXING

A. Bonding Slurry: Mix portland cement with water to a thick paint consistency.

B. Floor Topping: Mix concrete floor topping materials and water in appropriate drum-type batch machine mixer or truck mixer according to manufacturer's written instructions.

PART 3 - EXECUTION

3.1 PREPARATION

A. Existing Concrete: Remove existing surface treatments and deteriorated and unsound concrete. Mechanically abrade base slabs to produce a heavily scarified surface profile with an amplitude of 1/4 inch.

1. Prepare and clean existing base slabs according to concrete floor topping manufacturer's written instructions. Fill voids, cracks, and cavities in base slabs.
2. Saw cut contraction and construction joints in existing concrete to a depth of 1/2 inch and fill with semirigid joint filler.
3. To both sides of joint edges and at perimeter of existing base slab, mechanically remove a 4-inch-wide and 0- to 1-inch-deep, tapered wedge of concrete and retexture surface.

B. Install joint-filler strips where topping abuts vertical surfaces.

3.2 FLOOR TOPPING APPLICATION

A. Start floor topping application in presence of manufacturer's technical representative.

B. Monolithic Floor Topping: After textured-float finish is applied to fresh concrete of base slabs specified in Section 033000 "Cast-in-Place Concrete," place concrete floor topping while concrete is still plastic.

C. Deferred Floor Topping: Within 72 hours of placing base slabs, mix and scrub bonding slurry into dampened concrete to a thickness of 1/16 to 1/8 inch, without puddling. Place floor topping while slurry is still tacky.

D. Existing Concrete: Apply epoxy-bonding adhesive, mixed according to manufacturer's written instructions, and scrub into dry base slabs to a thickness of 1/16 to 1/8 inch, without puddling. Place floor topping while adhesive is still tacky.

E. Place concrete floor topping continuously in a single layer, tamping and consolidating to achieve tight contact with bonding surface. Do not permit cold joints or seams to develop within pour strip.

1. Screed surface with a straightedge and strike off to correct elevations.
2. Slope surfaces uniformly where indicated.
3. Begin initial floating, using bull floats to form a uniform and open-textured surface plane free of humps or hollows.

F. Finishing: Consolidate surface with power-driven floats as soon as concrete floor topping can support equipment and operator. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until concrete floor topping surface has a uniform, smooth, granular texture.

1. Hard Trowel Finish: After floating surface, apply first trowel finish and consolidate concrete floor topping by power-driven trowel without allowing blisters to develop.

Continue troweling passes and restraighten until surface is smooth and uniform in texture.

G. Construction Joints: Construct joints true to line with faces perpendicular to surface plane of concrete floor topping, at locations indicated or as approved by Architect.

1. Coat face of construction joint with epoxy adhesive at locations where concrete floor topping is placed against hardened or partially hardened concrete floor topping.

H. Contraction Joints: Form weakened-plane contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete floor topping when cutting action will not tear, abrade, or otherwise damage surface and before random contraction cracks develop.

1. Form joints in concrete floor topping over contraction joints in base slabs unless otherwise indicated.
2. Construct contraction joints for a combined depth equal to topping thickness and not less than one-fourth of base-slab thickness.
3. Construct contraction joints for a depth equal to one-half of concrete floor topping thickness, but not less than 1/2 inch deep.

3.3 PROTECTING AND CURING

A. General: Protect freshly placed concrete floor topping from premature drying and excessive cold or hot temperatures.

B. Evaporation Retarder: Apply evaporation retarder to concrete floor topping surfaces in hot, dry, or windy conditions before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying floor topping, but before float finishing.

C. Begin curing immediately after finishing concrete floor topping. Cure by one or a combination of the following methods, according to concrete floor topping manufacturer's written instructions:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for not less than seven days.
3. Curing Compound: Apply uniformly in two coats in continuous operations by power spray or roller according to manufacturer's written instructions.

3.4 JOINT FILLING

A. Prepare and clean contraction joints and install semirigid joint filler, according to manufacturer's written instructions, once topping has fully cured.

B. Install semirigid joint filler full depth of contraction joints. Overfill joint and trim semirigid joint filler flush with top of joint after hardening.

3.5 REPAIR

A. Defective Topping: Repair and patch defective concrete floor topping areas, including areas that have not bonded to concrete substrate.

END OF SECTION 035300

SECT 036200 - GROUT

PART 1 – GENERAL

1.1 WORK INCLUDED:

A. Furnish all labor, materials, equipment, and incidentals required and install grout complete as indicated and as specified.

1.2 RELATED WORK:

A. Section 031000 “Concrete Forming and Accessories”

B. Section 032000 “Concrete Reinforcing”

C. Section 033000 “Cast-in-Place Concrete”

D. Section 034100 “Precast Structural Concrete”

E. Section 042000 “Unit Masonry”

1.3 SUBMITTALS

A. Submit, in accordance with Section 013300, shop drawings and product data showing materials of construction and details of mixing and installation for:

1. Commercially manufactured nonshrink cementitious grout. Include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations and conformity to the specified standards.

2. Cement grout. Include the type and brand of cement, the gradation of fine aggregate, product data on any proposed admixtures and the proposed grout mix.

3. Concrete grout. Include data as required for concrete as delineated in Section.

B. Samples

1. Submit samples of commercially manufactured grout products.

2. Submit samples of aggregates proposed for use in mixes.

C. Laboratory Test Reports

1. Submit laboratory test reports as required for concrete as delineated in Section 033000.

D. Qualifications

1. Submit documentation that grout manufacturers have at least ten years' experience in the production and use of grouts proposed.

1.4 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM C33-Standard Specification for Concrete Aggregates

2. ASTM C150-Standard Specification for Portland Cement

3. ASTM C827- Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures

4. ASTM C1107-Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)

B. U.S Army Corps of Engineers Standard (CRD)

1. CRD-C 621-Corps of Engineers Specification for Nonshrink Grout

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE

A. Qualifications

1. Grout manufacturers shall have a minimum of ten years experience in the production and use of the type of grout proposed.

B. Pre-installation Meeting

1. At least ten days before grouting, hold a pre-installation meeting to review the requirements for surface preparation, mixing., and curing procedures for each product proposed for use. Notify parties involved with grouting, including the Engineer, of the meeting at least ten days prior to its scheduled date.

C. Services of Manufacturer`s Representative

1. Provide services of a field technician of the nonshrink grout manufacturer who has performed at least five projects of similar size and complexity during the last five years, to attend the pre-installation meeting, be present for the initial installation of each type of nonshrink grout, and to correct installation problems.

D. Field Testing

1. All field testing and inspection services will be provided by the Owner. Assist in the sampling of materials and cooperate by allowing free access to the work and permitting the use of ladders, scaffolding, and such incidental equipment as may be required.

2. Field testing of concrete grout will be as specified for concrete in Section 033000. Methods of testing will comply with the applicable ASTM Standards.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the jobsite in original, unopened packages, clearly labeled with the manufacturer's name, product identification, batch numbers and printed instructions.

B. Store materials in full compliance with the manufacturer`s recommendations. Limit total storage time from date of manufacture to date of installation to six months or the manufacturer`s recommended storage time, whichever is less.

C. Remove immediately from the site material which becomes damp, contains lumps, or is hardened and replace with acceptable material at no additional cost to Owner.

D. Deliver nonshrink cement-based grout as preblended, prepackaged mixes requiring only the addition of water.

PART 2 PRODUCTS

2.1 MATERIALS

A. Nonshrink Cementitious Grout

1. Nonshrink cementitious grouts: Conform to ASTM C1107, Grades B or C and CRD-C 621. Grouts shall be Portland cement based, contain a pre-proportioned blend of selected aggregates and shrinkage compensating agents and require only the addition of water.

2. Non shrink cementitious grouts shall not contain expansive cement or metallic particles. The grouts shall exhibit no shrinkage when tested in conformity with ASTM C827.
    a. General purpose nonshrink cementitious grout: Conform to the standards stated above. SikaGrout 212 by Sika Corp.; Set Grout by Master Builders, Inc.; Euco NS by The Euclid Chemical Co.; SikaGrout 212 by Sika Corp.; Five Star Products, Inc. or equal.

    b. Flowable (Precision) nonshrink cementitious grout: Conform to the standards stated above. Masterflow 928 by Master Builders.; Inc.; Hi-Flow Grout by the Euclid Chemical Co.; SikaGrout 212 by Sika Corp.; Five Star Grout by Five Star Products, Inc. or equal.

B. Cement Grout

1. A mixture of one part Portland cement conforming to ASTM C150, Types 1, 2, or 3 and one to two parts sand conforming to ASTM C33 with sufficient water to place the grout. The water content shall be sufficient to impart workability to the grout but not to the degree that it will allow the grout to flow.

C. Concrete Grout

1. Proportion with cement, coarse and fine aggregates, water, water reducer and air entraining agent to produce a mix having an average strength of 3500 psi at 28 days (2500 psi nominal strength). Coarse aggregate size shall be 3/8- in maximum. Slump shall not exceed 5-in.

2. Synthetic reinforcing shall be added to the concrete grout mix at the rate of 1.5 lbs of fibers per cubic yard of grout. Fibers shall be added from the manufacturers premeasured bags and according to the manufacturers recommendation in a manner which will ensure complete dispersion of the fiber bundles as single monofilaments within the concrete grout.

D. Water

1. Potable water free of oil, acid, alkali, salts, chlorides, organic matter, or other deleterious substances.

PART 3 EXECUTION

3.1 PREPARATION

A. Place grout were indicated or specified over cured concrete which has attained its full design strength unless otherwise approved by the Engineer.

B. Concrete surfaces to receive grout shall be clean and sound; free of ice, frost, dirt, grease, oil, form release agent, laitance, and paints and free of all loose material or foreign matter which may affect the bond or performance of the grout.

C. Roughen concrete surfaces by chipping, sandblasting, or other mechanical means to bond the grout to the concrete. Remove loose or broken concrete. Irregular voids or projecting coarse aggregate need not be removed if they are sound, free of laitance and firmly embedded into the parent concrete.

1. Air compressors used to clean surfaces in contact with grout shall be the oilless type or equipped with an oil trap in the air line to prevent oil from being blown into the surface.

D. Remove all loose rust, oil or other deleterious substances which may affect the bond or performance of the grout from metal embedment's or bottom of baseplates prior to the installation of the grout.

E. Wash concrete surfaces clean and then keep moist for at least 24 hours prior to the placement of cementitious or cement grout. Saturation may be achieved by covering the concrete with saturated burlap bags, use of a soaker hose, or flooding the surface. Upon completion of the 24-hour period, remove visible water from the surface prior grouting.

F. Provide forms for grout. Line or coat forms with release agents recommended by the grout manufacturer. Provide forms anchored in place and shored to resist the forces imposed by the grout and its placement.

G. Level and align the structural or equipment bearing plates in accordance with the structural requirements and the recommendations of the equipment manufacturer.

H. Support equipment during alignment and installation of grout by shims, wedges, blocks, or other approved means. The shims, wedges and blocking devices shall be prevented from bonding to the grout by bond breaking coatings and removed after grouting unless otherwise approved by the Engineer. Grout voids created by the removal of shims, wedges, and blocks.

3.2 INSTALLATION-GENERAL

A. Mix, apply and cure products in strict compliance with the manufacturer's recommendations and these specifications.

B. Provide staffing and equipment available for rapid and continuous mixing and placing. Get all necessary tools and materials ready and close at hand.

C. Maintain temperatures of the foundation plate, supporting concrete, and grout between 40 degrees F and 90 degrees F during grouting and for at least 24 hours thereafter or as recommended by the grout manufacturer, whichever is longer. Do not allow differential heating or cooling of baseplates and grout during the curing period.

D. Take special precautions for hot weather or cold weather grouting as recommended by the manufacturer when ambient temperature and/or the temperature of the materials in contact with the grout are outside of the 40-degree F and 90-degree F range.

E. Install grout to preserve the isolation between the elements on either side of the joint where grout is placed in the vicinity of an expansion or control joint.

F. Reflect all existing underlying expansion, control and construction joints through the grout.

3.3 INSTALLATION- CEMENT GROUTS AND NONSHRINK CEMENTITIOUS GROUTS

A. Mix in accordance with manufacturers recommendations. Do not add cement, sand, pea gravel, or admixtures without prior approval by the Engineer.

B. Do not mix by hand. Mix in a mortar mixer with moving blades. Pre-wet the mixer and empty excess water. Add premeasured amount of water for mixing, followed by the grout. Begin with

the minimum amount of water recommended by the manufacturer and then add the minimum additional water required to obtain workability. Do not exceed the manufacturer's maximum recommended water content.

C. Placements greater than 3-in in depth shall include the addition of clean, washed pea gravel to the grout mix when approved by the manufacturer. Comply with the manufacturer's recommendations for the size and amount of aggregate to be added.

D. Provide forms as specified in Paragraph 3.01F. Place grout into the designated areas and prevent segregation or entrapment of air. Do not vibrate grout to release air or to consolidate the material. Fill all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary.

E. Place grout rapidly and continuously to avoid cold joints. Do not place grout in layers. Do not add additional water to the mix (retemper) after initial stiffening.

F. Just before the grout reaches its final set, cut back the grout to the substrate at a 45-degree angle from the lower edge of bearing plate unless otherwise ordered and approved by the Engineer. Finished this surface with a wood float or brush finish.

G. Begin curing immediately after form removal, cutback, and finishing. Keep grout moist and within its recommended placement temperature range for at least 24 hours after placement or longer if recommended by the manufacturer. Saturate the grout surface by using saturated burlap bags, soaker hoses or ponding. Provide sunshades. If drying winds inhabit the ability of a given curing method to keep grout moist, erect wind breaks until wind is no longer a problem or curing is finished.

3.4 INSTALLATION-CONCRETE GROUT

A. Inspect slabs and walls finished under Section 033000 and scheduled to receive concrete grout. Scarify substrate for grout. Protect and keep the surface clean until placement of concrete grout.

B. Remove debris and clean the surface by sweeping and vacuuming of all dirt and other foreign materials. Pressure wash tank slabs. Do not flush debris into tank drain lines.

C. Saturate the concrete surface for at least 24 hours prior to placement of the concrete grout by ponding or by soaker hoses. Remove excess water just prior to placement of the concrete grout. Place a cement slurry immediately ahead of the concrete grout so that the slurry is moist when the approximately 1/16 to 1/8-in thick cement paste.

D. Place concrete grout to final grade using the scrapers of the installed mechanical equipment as a guide for surface elevation and to eliminate high and low spots. Unless specifically approved by the equipment manufacturer, mechanical scraper mechanisms powered by their motors shall not be used as a finishing machine or screed to push grout.

E. Steel trowel finish as specified in Section 033000.

3.5 SCHEDULE

A. The following list indicates where the particular types of grouts are to be used:

1. Hydraulic Nonshrink Grout: Use at all locations where hydraulic nonshrink grout is indicated such as parging at pipe, penetrations.

2. High Strength Nonshrink Grout: Use at all locations where high strength nonshrink grout is indicated such as below column baseplates and beneath equipment bearing plates.

3. Concrete Grout: Use for overlay of base concrete above slab in primary settling tank #4.

SECTION 040110 - MASONRY CLEANING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes cleaning the following:

1. Unit masonry surfaces.
2. Stone surfaces.

1.2 DEFINITIONS

A. Low-Pressure Spray: 100 to 400 psi; 4 to 6 gpm

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at a location to be determined.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 QUALITY ASSURANCE

A. Mockups: Prepare mockups of cleaning on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Cleaning: Clean an area approximately 25 sq. ft. for each type of masonry and surface condition.

a. Test cleaners and methods on samples of adjacent materials for possible adverse reactions. Do not test cleaners and methods known to have deleterious effect.
b. Allow a waiting period of not less than seven days after completion of sample cleaning to permit a study of sample panels for negative reactions.

PART 2 - PRODUCTS

2.1 CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F.

C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups of tetrasodium pyrophosphate (TSPP), 1/2 cup of laundry detergent, and 20 quarts of hot water for every 5 gal. of solution required.

D. Mold, Mildew, and Algae Remover, Job Mixed: Solution prepared by mixing 2 cups of tetrasodium pyrophosphate (TSPP), 5 quarts of 5 percent sodium hypochlorite (bleach), and 15 quarts of hot water for every 5 gal. of solution required.

E. Mild-Acid Cleaner: Manufacturer's standard mild-acid cleaner containing no muriatic (hydrochloric), hydrofluoric, or sulfuric acid; or ammonium bifluoride or chlorine bleaches.

1. Prosoco,Inc., Sure Klean Vana Trol or approved equal

2.2 CHEMICAL CLEANING SOLUTIONS

A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended in writing by chemical-cleaner manufacturer.

B. Acidic Cleaner Solution for Nonglazed Masonry and Unpolished Stone: Dilute acidic cleaner with water to produce hydrofluoric acid content of 3 percent or less, but not greater than that recommended in writing by chemical-cleaner manufacturer.

1. Stones: Use only on unpolished granite, unpolished dolomite marble, and siliceous sandstone.

C. Acidic Cleaner for Glazed Masonry and Polished Stone: Dilute acidic cleaner with water to concentration demonstrated by testing that does not etch or otherwise damage glazed or polished surface, but not greater than that recommended in writing by chemical-cleaner manufacturer.

1. Stones: Use only on polished granite and polished dolomite marble.

PART 3 - EXECUTION

3.1 PROTECTION

A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent paint removers and chemical cleaning solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.

1. Cover adjacent surfaces with materials that are proven to resist paint removers and chemical cleaners used unless products being used will not damage adjacent surfaces. Use protective materials that are waterproof and UV resistant. Apply masking agents according to manufacturer's written instructions. Do not apply liquid strippable masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.

3.2 CLEANING MASONRY, GENERAL

A. Cleaning Appearance Standard: Cleaned surfaces are to have a uniform appearance as viewed from 20 feet away by Architect.

B. Proceed with cleaning in an orderly manner; work from top to bottom of each scaffold width and from one end of each elevation to the other. Ensure that dirty residues and rinse water do not wash over dry, cleaned surfaces.

C. Use only those cleaning methods indicated for each masonry material and location.

1. Brushes: Do not use wire brushes or brushes that are not resistant to chemical cleaner being used.
2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that cleaning methods do not damage surfaces, including joints.

    a. Equip units with pressure gages.
    b. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone-shaped spray.
    c. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
    d. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F at flow rates indicated.

D. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging masonry surfaces. Keep wall wet below area being cleaned to prevent streaking from runoff.

E. Perform additional general cleaning, paint and stain removal, and spot cleaning of small areas that are noticeably different when viewed according to the "Cleaning Appearance Standard" Paragraph, so that cleaned surfaces blend smoothly into surrounding areas.

F. Water-Spray Application Method: Unless otherwise indicated, hold spray nozzle at least 6 inches from masonry surface and apply water in horizontal back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.

G. Chemical-Cleaner Application Methods: Apply chemical cleaners to masonry surfaces according to chemical-cleaner manufacturer's written instructions; use brush or spray application. Do not spray apply at pressures exceeding 50 psi. Do not allow chemicals to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.

H. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.

1. Apply neutralizing agent and repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.

3.3 PRELIMINARY CLEANING

A. Removing Plant Growth: Completely remove visible plant, moss, and shrub growth from masonry surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing remaining growth to dry as long as possible before removal. Remove loose soil and plant debris from open joints to whatever depth they occur.

B. Preliminary Cleaning: Before beginning general cleaning, remove extraneous substances that are resistant to planned cleaning methods. Extraneous substances include paint, calking, asphalt, and tar.

1. Carefully remove heavy accumulations of rigid materials from masonry surface with sharp chisel. Do not scratch or chip masonry surface.
2. Remove paint and calking with alkaline paint remover.

    a. Comply with requirements in "Paint Removal" Article.
    b. Repeat application up to two times if needed.

3. Remove asphalt and tar with solvent-type paste paint remover.

    a. Comply with requirements in "Paint Removal" Article.
    b. Apply paint remover only to asphalt and tar by brush without prewetting.
    c. Allow paint remover to remain on surface for 10 to 30 minutes.
    d. Repeat application if needed.

3.4 CLEANING MASONRY

A. Detergent Cleaning:

1. Wet surface with hot water applied by low-pressure spray.
2. Scrub surface with detergent solution using medium-soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
3. Rinse with hot water applied by low-pressure spray to remove detergent solution and soil.
4. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.

B. Mold, Mildew, and Algae Removal:

1. Wet surface with hot water applied by low-pressure spray.
2. Apply mold, mildew, and algae remover by brush or low-pressure spray.
3. Scrub surface with medium-soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used and that surface remains wet.
4. Rinse with hot water applied by low-pressure spray to remove mold, mildew, and algae remover and soil.
5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup.

C. Mild-Acid Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush or low-pressure spray.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer.
4. Rinse with cold water applied by low-pressure spray to remove chemicals and soil.
5. Repeat cleaning procedure above where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

END OF SECTION 040110

SECTION 040120.64 – BRICK AND UNIT MASONRY REPOINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes repointing joints with mortar.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at the project site; 145 Caesars Lane, New Windsor, NY 12553

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Quality-control program.

1.5 QUALITY ASSURANCE

A. Brick Masonry Repointing Specialist Qualifications: Engage an experienced brick masonry-repointing firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing masonry is insufficient experience for masonry repointing work.

B. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging masonry. Include provisions for supervising performance and preventing damage.

C. Mockups: Prepare mockups of brick masonry repointing to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Repointing: Rake out joints in two separate areas, each approximately 36 inches high by 48 inches wide, unless otherwise indicated, for each type of repointing required, and repoint one of the areas.

PART 2 - PRODUCTS

2.1 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II, except Type III may be used for cold-weather construction; gray where required for color matching of mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Masonry Cement: ASTM C91/C91M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Cemex S.A.B. de C.V.
b. Essroc.
c. Hanson Brick and Tile; Lehigh Hanson.
d. Lafarge North America Inc.
e. QUIKRETE.

D. Mortar Cement: ASTM C1329/C1329M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Lafarge North America Inc.

E. Mortar Sand: ASTM C144.

1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve a suitable match.
2. Color: Provide natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.

F. Mortar Pigments: ASTM C979/C979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Davis Colors.
b. LANXESS Corporation.
c. Solomon Colors, Inc.

G. Water: Potable.

2.2 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again, adding only enough water to produce a damp, unworkable mix that retains its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black, which is limited to 2 percent.

C. Do not use admixtures in mortar unless otherwise indicated.

D. Mixes: Mix mortar materials in the following proportions:

1. Pointing Mortar by Volume: ASTM C270, Proportion Specification, 1 part Portland cement, 1 part lime, and 6 parts sand.
2. Pointing Mortar by Property: ASTM C270, Property Specification, Type N unless otherwise indicated; with cementitious material limited to Portland cement and lime.

PART 3 - EXECUTION

3.1 REPOINTING

A. Rake out and repoint joints to the following extent:

1. All joints in areas indicated.
2. Joints indicated as sealant-filled joints. Seal joints according to Section 079200 "Joint Sealants."
3. Joints at locations of the following defects:

a. Holes and missing mortar.
b. Cracks that can be penetrated 1/4 inch or more by a knife blade 0.027 inch thick.
c. Cracks 1/16 inch or more in width and of any depth.
d. Hollow-sounding joints when tapped by metal object.
e. Eroded surfaces 1/4 inch or more deep.
f. Deterioration to a point that mortar can be easily removed by hand, without tools.
g. Joints filled with substances other than mortar.

B. Do not rake out and repoint joints where not required.

C. Rake out joints as follows, according to procedures demonstrated in approved mockup:

1. Remove mortar from joints to depth of not less than 1 inch and not less than that required to expose sound, unweathered mortar. Do not remove unsound mortar more than 2 inches deep; consult Architect for direction.
2. Remove mortar from brick and other masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
3. Do not spall edges of brick or other masonry units or widen joints. Replace or patch damaged brick or other masonry units as directed by Architect.

D. Notify Architect of unforeseen detrimental conditions including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.

E. Pointing with Mortar:

1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If the rinse water dries, dampen the joint surfaces before pointing.
2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch until a uniform depth is formed. Fully compact each layer and allow it to become thumbprint hard before applying next layer.
3. After deep areas have been filled to same depth as remaining joints, point joints by placing mortar in layers not greater than 3/8 inch. Fully compact each layer and allow to become thumbprint hard before applying next layer. Where existing masonry units have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed masonry surfaces or to feather-edge the mortar.
4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from joint edge by brushing.
5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.
6. Hairline cracking within mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

F. Where repointing work precedes cleaning of existing masonry, allow mortar to harden at least 30 days before beginning cleaning work.

3.2 FINAL CLEANING

A. After the mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

END OF SECTION 040120.64

SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Concrete building brick.
3. Decorative concrete masonry units.
4. Pre-faced concrete masonry units.
5. Concrete face brick.
6. Clay face brick.
7. Building (common) brick.
8. Hollow brick.
9. Structural clay facing tile.

1.2 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For reinforcing steel. Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.

C. Samples for Verification: For each type and color of exposed masonry unit and colored mortar.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of product. For masonry units, include material test reports substantiating compliance with requirements.

B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.

1.5 QUALITY ASSURANCE

A. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.

1. Build sample panels for each type of exposed unit masonry construction in sizes approximately 48 inches long by 48 inches high by full thickness.

1.6 FIELD CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 feet vertically and horizontally of a walking surface.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

B. Integral Water Repellent: Provide units made with integral water repellent for exposed units and where indicated.

C. CMUs: ASTM C90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2000 psi.
2. Density Classification: Normal weight unless otherwise indicated.

D. Concrete Building Brick: ASTM C55.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 4950 psi.
2. Density Classification: Lightweight.

E. Decorative CMUs: ASTM C90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2000 psi.
2. Density Classification: Medium weight.
3. Pattern and Texture: as indicated on the project plans.

F. Pre-faced CMUs: Lightweight hollow concrete units complying with ASTM C90, with manufacturer's standard smooth resinous facing complying with ASTM C744.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2000 psi.
2. Size: Manufactured with pre-faced surfaces having 1/16-inch-wide returns of facing to create 1/4-inch-wide mortar joints.
3. Colors and Patterns: As selected by Architect from manufacturer's full range.

G. Concrete Face Brick: ASTM C1634.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 4950 psi.
2. Density Classification: Normal weight.
3. Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 15-5/8 inches long.
4. Texture: Ground-face finish.

    a. Match Architect's samples.

5. Colors: As selected by Architect from manufacturer's full range.

2.3 CONCRETE LINTELS

A. Concrete Lintels: ASTM C1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than that of CMUs.

2.4 BRICK

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Clay Face Brick: Facing brick complying with ASTM C216 or hollow brick complying with ASTM C652, Class H40V (void areas between 25 and 40 percent of gross cross-sectional area).

1. Grade: SW.
2. Type: HBS.
3. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 4950 psi.
4. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested according to ASTM C67.
5. Efflorescence: Provide brick that has been tested according to ASTM C67 and is rated "not effloresced."
6. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing according to ASTM C67 with no observable difference in the applied finish when viewed from 10 feet.
7. Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.

C. Building (Common) Brick: ASTM C62, Grade SW.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 4950 psi.
2. Size: Match size of face brick.

D. Hollow Brick: ASTM C652, Grade SW, Class H40V (void areas between 25 and 40 percent of gross cross-sectional area), Type HBS.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 4950 psi.
2. Efflorescence: Provide brick that has been tested according to ASTM C67 and is rated "not effloresced."
3. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing according to ASTM C67 with no observable difference in the applied finish when viewed from 10 feet.
4. Size (Actual Dimensions): 5-5/8 inches wide by 3-5/8 inches high by 11-5/8 inches long.

2.5 STRUCTURAL CLAY FACING TILE

A. General:

1. Where reinforced masonry is indicated, provide multicored units designed for use in reinforced, grouted masonry, either with vertical cores and with webs notched to receive

horizontal reinforcement, or with horizontal cores and with holes in bed shells for placement of grout and to receive vertical reinforcement.

2. Provide special shapes where required for corners, jambs, coved bases, sills, and other special conditions indicated, including applications that cannot be produced by sawing standard units.

B. Glazed Structural Clay Facing Tile: ASTM C126, Grade S (Select).

1. Sizes: 6T Series with actual face dimensions of 5 inches high by 11-11/16 inches long by widths indicated.
2. Sizes: 8W Series with actual face dimensions of 7-5/8 inches high by 15-5/8 inches long by widths indicated.
3. Provide Type I (single-faced units) where only one finished face is exposed when units are installed, and Type II (double-faced units) where two opposite finished faces are exposed when units are installed.
4. Colors and Patterns: As selected by Architect from manufacturer's full range.

2.6 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C91/C91M.

E. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in masonry mortar.

F. Colored Cement Products: Packaged blend made from portland cement and hydrated lime or masonry cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.

1. Colored Portland Cement-Lime Mix

2. Colored Masonry Cement

G. Aggregate for Mortar: ASTM C144.

1. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
2. White-Mortar Aggregates: Natural white sand or crushed white stone.
3. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

H. Aggregate for Grout: ASTM C404.

I. Epoxy Pointing Mortar: ASTM C395, epoxy-resin-based material formulated for use as pointing mortar for glazed or pre-faced masonry units (and approved for such use by manufacturer of units); in color indicated or, if not otherwise indicated, as selected by Architect or owner from manufacturer's colors.

J. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

K. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.

L. Water: Potable.

2.7 REINFORCEMENT

A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60.

B. Masonry-Joint Reinforcement, General: ASTM A951/A951M.

1. Interior Walls: Hot-dip galvanized carbon steel.
2. Exterior Walls: Hot-dip galvanized carbon steel.
3. Wire Size for Side Rods: 0.148-inch diameter.
4. Wire Size for Cross Rods: 0.148-inch diameter.
5. Wire Size for Veneer Ties: 0.148-inch diameter.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

C. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder or truss type with single pair of side rods.

D. Masonry-Joint Reinforcement for Multiwythe Masonry:

1. Ladder type with one side rod at each face shell of hollow masonry units more than 4 inches wide, plus one side rod at each wythe of masonry 4 inches wide or less.
2. Tab type, either ladder or truss design, with one side rod at each face shell of backing wythe and with rectangular tabs sized to extend at least halfway through facing wythe, but with at least 5/8-inch cover on outside face.
3. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum horizontal play of 1/16 inch and maximum vertical adjustment of 1-1/4 inches. Size ties to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face. Ties have hooks or clips to engage a continuous horizontal wire in the facing wythe.

E. Masonry-Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.187-inch-diameter, hot-dip galvanized carbon steel continuous wire.

2.8 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating.
2. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
3. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.

1. Wire: Fabricate from 3/16-inch-diameter, hot-dip galvanized-steel wire.

D. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch-diameter, hot-dip galvanized-steel wire.
2. Tie Section: Triangular-shaped wire tie made from 0.187-inch-diameter, hot-dip galvanized-steel wire.

E. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch-thick steel sheet, galvanized after fabrication
2. Tie Section: Triangular-shaped wire tie made from 0.187-inch-diameter, hot-dip galvanized-steel wire.
3. Corrugated-Metal Ties: Metal strips not less than 7/8 inch wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch made from 0.060-inch-thick steel sheet, galvanized after fabrication with dovetail tabs for inserting into dovetail slots in concrete.

F. Partition Top Anchors: 0.105-inch-thick metal plate with a 3/8-inch-diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

G. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A153/A153M.

H. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist a 100-lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.

2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.075-inch-thick steel sheet, galvanized after fabrication.
3. Fabricate wire ties from 0.187-inch-diameter, hot-dip galvanized-steel wire unless otherwise indicated.
4. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a rib-stiffened, sheet metal anchor section.
5. Screw-Attached, Masonry-Veneer Anchors: Wire tie and a gasketed sheet metal anchor section, with pronged legs of length to match thickness of insulation or sheathing and raised rib-stiffened strap to provide a slot for inserting wire tie.
6. Seismic Masonry-Veneer Anchors: Connector section and rib-stiffened, sheet metal anchor section with screw holes top and bottom, and having slotted holes for inserting connector section. Connector section consists of a rib-stiffened, sheet metal bent plate, sheet metal clip, or wire tie with rigid PVC extrusion designed to engage continuous wire.
7. Coated, Steel Drill Screws for Steel Studs: ASTM C954 except with hex washer head and neoprene or EPDM washer, No. 10 diameter, and with coating with salt-spray resistance to red rust of more than 800 hours according to ASTM B117.

2.9 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch thick.
2. Copper: ASTM B370, Temper H00, cold-rolled copper sheet, 16-oz./sq. ft. weight or 0.0216 inch thick or ASTM B370, Temper H01, high-yield copper sheet, 12-oz./sq. ft. weight or 0.0162 inch thick.
3. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
4. Fabricate metal drip edges from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
5. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
6. Fabricate metal expansion-joint strips from stainless steel or copper to shapes indicated.

B. Flexible Flashing: Use one of the following unless otherwise indicated:
1. Copper-Laminated Flashing: 5-oz./sq. ft. copper sheet bonded between two layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.
2. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch.
3. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.040 inch.
4. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy.
5. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D4637/D4637M, 0.040 inch thick.

C. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 or PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

D. Weep/Cavity Vent Products: Use one of the following unless otherwise indicated:
   1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.
   2. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard.
   3. Vinyl Weep Hole/Vent: Units made from flexible PVC, designed to fit into a head joint and consisting of a louvered vertical leg, flexible wings to seal against ends of masonry units, and a top flap to keep mortar out of the head joint; in color selected by Architect.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

   1. Configuration: Provide one of the following:

      a. Strips, full depth of cavity and 10 inches high, with dovetail shaped notches 7 inches deep that prevent clogging with mortar droppings.
      b. Strips, not less than 3/4 inch thick and 10 inches high, with dimpled surface designed to catch mortar droppings and prevent weep holes from clogging with mortar.
      c. Sheets or strips full depth of cavity and installed to full height of cavity.
      d. Sheets or strips not less than 3/4 inch thick and installed to full height of cavity, with additional strips 4 inches high at weep holes and thick enough to fill entire depth of cavity and prevent weep holes from clogging with mortar.

2.11 MASONRY-CELL FILL

A. Loose-Fill Insulation: Perlite complying with ASTM C549, Type II (surface treated for water repellency and limited moisture absorption) or Type IV (surface treated for water repellency and to limit dust generation).

B. Lightweight-Aggregate Fill: ASTM C331/C331M.

2.12 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

2.13 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime or masonry cement mortar unless otherwise indicated.
3. For exterior masonry, use portland cement-lime or masonry cement mortar.
4. For reinforced masonry, use portland cement-lime or masonry cement mortar.
5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the mortar strength indicated on the project plans.

D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.
3. Mix to match Architect's sample.
4. Application: Use pigmented mortar for exposed mortar joints with the following units:

    a. Decorative CMUs.
    b. Pre-faced CMUs.
    c. Concrete face brick.
    d. Clay face brick.
    e. Hollow brick.
    f. Glazed structural clay facing tile.

E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.

1. Mix to match Architect's sample.
2. Application: Use colored-aggregate mortar for exposed mortar joints with the following units:

a. Decorative CMUs.
b. Pre-faced CMUs.
c. Concrete face brick.
d. Clay face brick.
e. Hollow brick.
f. Glazed structural clay facing tile.

F. Grout for Unit Masonry: Comply with ASTM C476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C143/C143M.

G. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's written instructions.

1. Application: Use epoxy pointing mortar for exposed mortar joints with the following units:

a. Pre-faced CMUs.
b. Glazed structural clay facing tile.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

C. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested according to ASTM C67. Allow units to absorb water so they are damp but not wet at time of laying.

3.2 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.3 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

D. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

E. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.4 MORTAR BEDDING AND JOINTING

A. Lay hollow brick and CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

B. Lay solid masonry units and hollow brick with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Lay structural clay tile as follows:

1. Lay vertical-cell units with full head joints unless otherwise indicated. Provide bed joints with full mortar coverage on face shells and webs.
2. Lay horizontal-cell units with full bed joints unless otherwise indicated. Keep drainage channels, if any, free of mortar. Form head joints with sufficient mortar so excess will be squeezed out as units are placed in position. Butter both sides of units to be placed, or butter one side of unit already in place and one side of unit to be placed.
3. Maintain joint thicknesses indicated except for minor variations required to maintain bond alignment. If not indicated, lay walls with 1/4- to 3/8-inch-thick joints.

D. Rake out mortar joints at pre-faced CMUs and glazed structural clay tile to a uniform depth of 1/4 inch and point with epoxy mortar to comply with epoxy-mortar manufacturer's written instructions.

E. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

F. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.5 COMPOSITE MASONRY

A. Bond wythes of composite masonry together using one of the following methods:

1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 2.67 sq. ft. of wall area spaced not to exceed 24 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.
2. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.

    a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
    b. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) reinforcement with continuous horizontal wire in facing wythe attached to ties.

B. Collar Joints: Solidly fill collar joints by parging face of first wythe that is laid and shoving units of other wythe into place.

C. Collar Joints in Clay Tile Masonry: After each course is laid, fill the vertical, longitudinal joint between wythes solidly with mortar at exterior walls, except cavity walls, and interior walls and partitions.

D. Corners: Provide interlocking masonry unit bond in each wythe and course at corners unless otherwise indicated.

E. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, bond walls together as follows:

1. Provide individual metal ties not more than 16 inches o.c.
2. Provide continuity with masonry-joint reinforcement by using prefabricated T-shaped units.
3. Provide rigid metal anchors not more than 24 inches o.c. If used with hollow masonry units, embed ends in mortar-filled cores.

3.6 CAVITY WALLS

A. Bond wythes of cavity walls together using one of the following methods:

1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 2.67 sq. ft. of wall area spaced not to exceed 24 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.
2. Masonry-Joint Reinforcement: Installed in horizontal mortar joints.

    a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
    b. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) reinforcement with continuous horizontal wire in facing wythe attached to ties.
    c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable-type (two-piece-type) reinforcement with continuous horizontal wire in facing wythe attached to ties to allow for differential movement regardless of whether bed joints align.

B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

C. Parge cavity face of backup wythe in a single coat approximately 3/8 inch thick. Trowel face of parge coat smooth.

D. Installing Cavity Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

3.7 ANCHORED MASONRY VENEERS

A. Anchor masonry veneers to wall framing and concrete and masonry backup with seismic masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached and seismic anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Embed tie sections, connector sections and continuous wire in masonry joints.
3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 18 inches o.c. vertically and 24 inches o.c. horizontally, with not less than one anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.
5. Space anchors as indicated, but not more than 16 inches o.c. vertically and 25 inches o.c. horizontally, with not less than one anchor for each 2.67 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.
6. Space anchors as indicated, but not more than 18 inches o.c. vertically and horizontally. Install additional anchors within 12 inches of openings and at intervals, not exceeding 24 inches, around perimeter.

3.8 MASONRY-CELL FILL

A. Pour lightweight-aggregate fill into cavities to fill void spaces. Maintain inspection ports to show presence of fill at extremities of each pour area. Close the ports after filling has been confirmed. Limit the fall of fill to one story high, but not more than 20 feet.

3.9 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.10 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:

1. Provide an open space not less than 1 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.11 FLASHING, WEEP HOLES, AND CAVITY VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install cavity vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches, and through inner wythe to within 1/2 inch of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner wythe and turn flashing up approximately 2 inches on interior face.
3. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
4. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
5. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.

C. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.

1. Use specified weep/cavity vent products to form weep holes.
2. Space weep holes 24 inches o.c. unless otherwise indicated.
3. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.

D. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

E. Install cavity vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form cavity vents.

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.12 REINFORCED UNIT MASONRY

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches.

3.13 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Special inspections according to Level B & C in TMS 402/ACI 530/ASCE 5.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

E. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C67 for compressive strength.

F. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.

G. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.

H. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for mortar air content and compressive strength.

I. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.

3.14 PARGING

A. Parge exterior faces of below-grade masonry walls, where indicated, in two uniform coats to a total thickness of 3/4 inch. Dampen wall before applying first coat, and scarify first coat to ensure full bond to subsequent coat.

B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot. Form a wash at top of parging and a cove at bottom.

C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.15 REPAIRING, POINTING, AND CLEANING

A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
3. Protect adjacent surfaces from contact with cleaner.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

3.16 MASONRY WASTE DISPOSAL

A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Do not dispose of masonry waste as fill within 18 inches of finished grade.

B. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000

SECTION 042613 - MASONRY VENEER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brick.
2. Concrete face brick.
3. Mortar materials.
4. Ties and anchors.
5. Embedded flashing.
6. Accessories.
7. Mortar mixes.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type and color of brick mortar.

1.3 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of product.

1.4 MOCKUPS

A. Sample Panels: Build sample panels to verify selections made under Sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 014000 "Quality Requirements" for mockups.

1. Build sample panels for typical exterior and interior walls in sizes approximately 48 inches long by 36 inches high by full thickness.

1.5 FIELD CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed with or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602.

B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602.

PART 2 - PRODUCTS

2.1 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects will be exposed in the completed Work and will be within 20 ft. vertically and horizontally of a walking surface.

2.2 BRICK

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units.

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

TYPE “A” Basis of Design:

B. Clay Face Brick: Facing brick complying with ASTM C216 or hollow brick complying with ASTM C652, Class H40V (void areas between 25 and 40 percent of gross cross-sectional area).

1. Manufacturer: Bowerston
2. Series: #1525 Buff Flash Sand Face Modular
3. Color: Buff
4. Grade: SW
5. Type: HBS Facebrick
6. Style – Extruded
7. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested according to ASTM C67.
8. Efflorescence: Provide brick that has been tested according to ASTM C67 and is rated "not effloresced."
9. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing according to ASTM C67 with no observable difference in the applied finish when viewed from 10 feet or shall have a history of successful use in Project's area.
10. Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.

TYPE “B” Basis of Design:

C. Clay Face Brick: Facing brick complying with ASTM C216 or hollow brick complying with ASTM C652, Class H40V (void areas between 25 and 40 percent of gross cross-sectional area).

1. Manufacturer: Bowerston
2. Series: #1525 Buff Flash Sand Face Norman
3. Color: Buff
4. Grade: SW
5. Type: HBS Facebrick
6. Style – Extruded
7. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested according to ASTM C67.
8. Efflorescence: Provide brick that has been tested according to ASTM C67 and is rated "not effloresced."
9. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing according to ASTM C67 with no observable difference in the applied finish when viewed from 10 feet or shall have a history of successful use in Project's area.
10. Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 11-5/8 inches long.

2.3 MORTAR MATERIALS

A. Masonry Cement: ASTM C91/C91M.
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Lehigh Northeast Cement Co.
      b. Lafarge Building Materials, Inc
      c. Quikrete, a Custom Building Products Co.

B. Preblended Dry Mortar Mix: Packaged blend made from masonry cement, sand, and admixtures and complying with ASTM C1714/C1714M.

   1. Preblended Dry Masonry Cement Mortar Mix:
      a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
         1) Lehigh Northeast Cement Co.
         2) Lafarge Building Materials, Inc
         3) Quikrete, a Custom Building Products Co.

C. Aggregate for Mortar: ASTM C144.

   1. White-Mortar Aggregates: Natural white sand or crushed white stone.
   2. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

D. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C and recommended by manufacturer for use in masonry mortar of composition indicated.
      a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
         1) Lehigh Northeast Cement Co.

2) Lafarge Building Materials, Inc
3) Quikrete, a Custom Building Products Co.

E. Water: Potable.

2.4 TIES AND ANCHORS

A. General: Ties and anchors extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on the outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M, with ASTM A153/A153M, Class B-2 coating.
2. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.

C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch diameter, hot-dip galvanized steel wire.
2. Tie Section: Triangular-shaped wire tie made from 0.25-inch diameter, hot-dip galvanized steel wire.

D. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch thick, steel sheet, galvanized after fabrication 0.109-inch thick, stainless-steel sheet.
2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.

E. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist a 100 lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.

2. Masonry-Veneer Anchors; Double-Pintle Type: Hot dipped galvanized with 6” standard hook section to be tied into eyewire attached to welded wire truss reinforcing in CMU back up wall, projecting horizontal leg with slots for vertical legs of double pintle wire tie.
   a. Hohmann & Barnard, Inc.

   b. Wire Bond Company

2.5 EMBEDDED FLASHING

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Fabricate metal drip edges from stainless steel. Extend at least 3 inches into the wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
2. Fabricate metal sealant stops from stainless steel. Extend at least 3 inches into the wall and out to the exterior face of wall. At the exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.

B. Flexible Flashing: Where concealed flashing is required, use the following unless otherwise indicated:
1. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D4637/D4637M, 40 mil thick.

C. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

E. Termination Bars for Flexible Flashing, Flanged: Stainless steel sheet 0.019 inch by 1-1/2 inches with a 3/8-inch flange at top and bottom.

2.6 ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Weep/Vent Products: Use the following unless otherwise indicated:

1. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard.

a. Hohmann & Barnard, Inc.

b. Wire Bond Company

C. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
1. Mortar Deflector: Strips, full depth of cavity 1-1/2 inches thick 2 inches and 10 inches high, with dovetail-shaped notches that prevent clogging with mortar droppings.

a. Mortar Net Solutions

b. Mason Pro, Inc.

2.7 MORTAR MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use masonry cement mortar unless otherwise indicated.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Use Type N unless another type is indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

C. Wetting of Brick: Wet brick before laying if the initial rate of absorption exceeds 30 g/30 sq. in per minute when tested in accordance with ASTM C67/C67M. Allow units to absorb water so they are damp but not wet at time of laying.

3.2 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than a plus or minus 1/4 inch in a story height or 1/2-inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 ft., or 1/2-inch maximum.

2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 ft., 1/4 inch in 20 ft., or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 ft. maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 ft., or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 ft, or 1/2-inch maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.

3.3 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in Flemish bond at every 6th course; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

3.4 MORTAR BEDDING AND JOINTING

A. Lay masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.5 ANCHORED MASONRY VENEERS

A. Anchor masonry veneers to concrete and masonry backup with seismic masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Embed tie sections, connector sections and continuous wire in masonry joints.

3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
4. Space anchors as indicated, but not more than 18 inches o.c. vertically and horizontally. Install additional anchors within 12 inches of openings and at intervals, not exceeding 24 inches, around perimeter.

B. Provide not less than 2 inches of airspace between the back of masonry veneer and face of insulation.

3.6 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete to comply with the following:

1. Provide an open space not less than 1/2 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.7 FLASHING, WEEP HOLES, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. Extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under water-resistive barrier, lapping at least 4 inches.
3. At lintels and shelf angles, extend flashing 6 inches minimum, to edge of next full unit at each end. At heads and sills, extend flashing 6 inches minimum, to edge of next full unit and turn ends up not less than 2 inches to form end dams.
4. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.

C. Install weep holes in veneers in head joints of first course of masonry immediately above embedded flashing.

1. Use specified weep/cavity vent products to form weep holes.
2. Space weep holes 24 inches o.c. unless otherwise indicated.

D. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Accessories" Article.

E. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form vents.

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. Allow inspectors to access scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements will be at Contractor's expense.

B. Inspections: Special inspections in accordance with Level 2 in TMS 402.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.

C. Testing Prior to Construction: One set of tests.

D. Clay Masonry Unit Test: For each type of unit provided, in accordance with ASTM C67/C67M for compressive strength.

E. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, in accordance with ASTM C780.

3.9 CLEANING

A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
2. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

3.10 MASONRY WASTE DISPOSAL

A. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042613

SECTION 051200 - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural steel.
2. Shrinkage-resistant grout.

1.2 DEFINITIONS

A. Structural Steel: Steel Elements indicated on Drawings and as described in ANSI/AISC 303.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: If required by EOR, to be conducted at Project site.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Anchor rods.
4. Threaded rods.
5. Shop primer.
6. Galvanized-steel primer.
7. Etching cleaner.
8. Galvanized repair paint.
9. Shrinkage-resistant grout.

B. Shop Drawings: Show fabrication of structural-steel components.

C. Delegated-Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Mill test reports for structural-steel materials, including chemical and physical properties.

C. Source quality-control reports.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with applicable provisions of the following specifications and documents:

1. ANSI/AISC 303.
2. ANSI/AISC 360.
3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

B. Connection Design Information:

1. Option 1: Completed connection details indicated on Drawings.

2. Option 2: Fabricator's experienced steel detailer shall select or complete connections in accordance with ANSI/AISC 303.

    a. Select and complete connections using schematic details indicated and ANSI/AISC 360.

3. Option 3 and 3A: Design connections in accordance with ANSI/AISC 303 by fabricator's qualified professional engineer. Member reinforcement at connections is indicated on Drawings.

    a. Use Load and Resistance Factor Design; data are given at factored-load level.

4. Option 3 and 3B: Design connections and final configuration of member reinforcement at connections in accordance with ANSI/AISC 303 by fabricator's qualified professional engineer.

    a. Use Load and Resistance Factor Design; data are given at factored-load level.

C. Moment Connections: Type FR, fully restrained.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A992/A992M.

B. Channels, Angles, M-Shapes, S-Shapes: ASTM A36/A36M.

C. Plate and Bar: ASTM A36/A36M.

D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade C structural tubing.
   1. Rectangular HSS: Fy = 50 KSI; Fu = 62 KSI
   2. Round HSS: Fy = 46 KSI, Fu = 62 KSI

E. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.

F. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

   1. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1, compressible-washer type with plain finish.

B. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490, Type 1, heavy-hex steel structural bolts or Grade F2280 tension-control, bolt-nut-washer assemblies with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

   1. Direct-Tension Indicators: ASTM F959/F959M, Type 490-1, compressible-washer type with plain finish.

C. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

   1. Finish: Hot-dip or mechanically deposited zinc coating.
   2. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1, compressible-washer type with mechanically deposited zinc coating, baked epoxy-coated finish.

D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, heavy-hex head assemblies, consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

   1. Finish: Mechanically deposited zinc coating.

E. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

2.4 RODS

A. Unheaded Anchor Rods: ASTM F1554, Grade 36.

1. Configuration: Hooked.
2. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

B. Headed Anchor Rods: ASTM F1554, Grade 36, straight.

1. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

C. Threaded Rods: ASTM A36/A36M.

1. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

2.5 FORGED-STEEL STRUCTURAL HARDWARE

A. Clevises and Turnbuckles: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1035.

2.6 PRIMER

A. Steel Primer:

1. Galvanizing Repair Paint: Repair damaged areas of galvanization from welding, cutting, burning, etc. in accordance with ASTM A780.
2. Comply with Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."
3. SSPC-Paint 23, latex primer.
4. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.7 SHRINKAGE-RESISTANT GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.8 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

B. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

2.9 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened, unless indicated as T.C. on plans.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.10 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.

2.11 SHOP PRIMING

A. Shop prime steel surfaces, except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces of high-strength bolted, slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces unless indicated to be painted.
6. Surfaces enclosed in interior construction.

B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards. Coordinate minimum surface-preparation requirements with selection of primers, paint, and coating systems:

1. SSPC-SP 2.
2. SSPC-SP 3.
3. SSPC-SP 7 (WAB)/NACE WAB-4.
4. SSPC-SP 6 (WAB)/NACE WAB-3.

C. Surface Preparation of Galvanized Steel: If galvanized steel is indicated to be painted, prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner or in accordance with SSPC-SP 16.

D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.12 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform shop tests and inspections.

1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
2. Bolted Connections: Inspect and test shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

    a. Liquid Penetrant Inspection: ASTM E165/E165M.
    b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
    c. Ultrasonic Inspection: ASTM E164.
    d. Radiographic Inspection: ASTM E94/E94M.

4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M.
5. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedded items for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.

C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

3.3 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.

1. Joint Type: Snug tightened, unless indicated as T.C. on plans.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform Special Inspection as indicated in Specification 014535 “Code Required Special Inspections and Procedures” and on the project plans.

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

1. Bolted Connections: Inspect and test bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.

a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1) Liquid Penetrant Inspection: ASTM E165/E165M.
2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3) Ultrasonic Inspection: ASTM E164.
4) Radiographic Inspection: ASTM E94/E94M.

END OF SECTION 051200

SECTION 052100 - STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. K-series steel joists.
2. K-series steel joist substitutes.
3. LH-series long-span steel joists.
4. DLH-series long-span steel joists.
5. Steel joist girders.
6. Steel joist accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.

B. Shop Drawings:

1. Include layout, designation, number, type, location, and spacing of joists.
2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Manufacturer certificates.

C. Mill Certificates: For each type of bolt.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."

1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Canam Steel Corporation; Canam Group, Inc.
2. New Millennium Building Systems, LLC.
3. Vulcraft; Nucor Vulcraft Group.

2.2 STEEL JOISTS

A. K-Series Steel Joist: Manufactured steel joists of type indicated according to "Standard Specification for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.

1. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.

2.3 COATINGS

A. As indicated on the project plans.

2.4 STEEL JOIST ACCESSORIES

A. Bridging:

1. Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.

B. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction.

1. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated on Drawings.

C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish:
   a. Interior: Plain
   b. Exterior: Hot-dip zinc coating, ASTM A153/A153M, Class C

D. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written instructions, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.

C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Bolt joists to supporting steel framework using carbon-steel bolts.

E. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with RCSC's "Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts" for high-strength structural bolt installation and tightening requirements.

F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.2 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform special inspections as indicated in Specification 014535 “Code-Required Special Inspections and Procedures” and on the project plans.

B. Visually inspect field welds according to AWS D1.1/D1.1M.

C. Visually inspect bolted connections.

D. Prepare test and inspection reports.

END OF SECTION 052100

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof deck.
2. Noncomposite form deck.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Roof deck.
2. Noncomposite form deck.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Research reports.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

2.2 ROOF DECK

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Canam Steel Corporation; Canam Group, Inc.
2. New Millennium Building Systems, LLC.
3. Nucor Corp.

B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), G90 zinc coating.
2. Deck rofile, depth and uncoated steel thickness to be as indicated on the project plans.

2.3 NONCOMPOSITE FORM DECK

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Canam Steel Corporation; Canam Group, Inc.
2. New Millennium Building Systems, LLC.
3. Nucor Corp.

B. Noncomposite Form Deck: Fabricate ribbed-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:

1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33, G90 zinc coating.
2. Deck profile, depth and thickness as indicated on the project plans.

2.4 ACCESSORIES

A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 50,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

G. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.

H. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

C. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

D. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

E. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

F. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

G. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space welds not more than 12 inches apart with at least one weld at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and weld or mechanically fasten.

H. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

I. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

J. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.2 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.

3.3 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform Special Inspections as indicated in Specification 014535 “Code-Required Special Inspections and Procedures” and on the project plans.

B. Field welds will be subject to inspection.

C. Prepare test and inspection reports.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Load-bearing wall framing.
2. Interior non-load-bearing wall framing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Cold-formed steel framing materials.
2. Load-bearing wall framing.
3. Exterior non-load-bearing wall framing.
4. Interior non-load-bearing wall framing.
5. Vertical deflection clips.
6. Single deflection track.
7. Double deflection track.
8. Drift clips.
9. Post-installed anchors.
10. Power-actuated anchors.

B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product certificates.

C. Product test reports.

D. Research Reports:

1. For post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

D. Comply with AISI S230 "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ClarkDietrich.
2. MarinoWARE.
3. MBA Building Supplies.

2.2 PERFORMANCE REQUIREMENTS

A. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:

1. Wall Studs: AISI S211.
2. Headers: AISI S212.
3. Lateral Design: AISI S213.

B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.3 COLD-FORMED STEEL FRAMING MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:

1. Grade: As required by structural performance.

2. Coating: G60, A60, AZ50, or GF30.

B. Steel Sheet for Vertical Deflection Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: As required by structural performance.
2. Coating: G60.

2.4 LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness and Flange Width: as indicated on the project plans.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and matching minimum base-metal thickness of steel studs.

C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness and Flange Width: as indicated on the project plans.

2.5 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness and Flange Width: as indicated on the project plans.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and matching minimum base-metal thickness of steel studs.

C. Vertical Deflection Clips: Manufacturer's standard clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ClarkDietrich.
b. MarinoWARE.
c. Simpson Strong-Tie Co., Inc.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure.

E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.6 INTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness and Flange Width: as indicated on the project plans.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and matching minimum base-metal thickness of steel studs.

C. Vertical Deflection Clips: Manufacturer's standard clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ClarkDietrich.
b. MarinoWARE.
c. Simpson Strong-Tie Co., Inc.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure.

E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.7 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated.

2.8 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.

B. Anchor Bolts: ASTM F1554, Grade 36, threaded carbon-steel carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153/A153M, Class C.

C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58, or ICC-ES AC308 as appropriate for the substrate.

1. Uses: Securing cold-formed steel framing to structure.
2. Type: Torque-controlled expansion anchor or adhesive anchor.
3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F593, and nuts, ASTM F594.

D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

2.9 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A780/A780M or SSPC-Paint 20.

B. Cement Grout: Portland cement, ASTM C150/C150M, Type I; and clean, natural sand, ASTM C404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.

D. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.

E. Sill Sealer Gasket: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.

C. Install load-bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sill sealer gasket at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.2 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

C. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

D. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

E. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

F. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

G. Install insulation, per Architectural Plans, in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

H. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.3 INSTALLATION OF LOAD-BEARING WALL FRAMING

A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:

1. Anchor Spacing: As shown on Shop Drawings.

B. Squarely seat studs against top and bottom tracks, with gap not exceeding 1/8 inch between the end of wall-framing member and the web of track.

1. Fasten both flanges of studs to top and bottom tracks.
2. Space studs as follows:

a. Stud Spacing: As indicated on Drawings.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.

D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

E. Align floor and roof framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.

F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure.

G. Install headers over wall openings wider than stud spacing. Locate headers above openings. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.

1. Frame wall openings with not less than a double stud at each jamb of frame. Fasten jamb members together to uniformly distribute loads.
2. Install tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.

1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

I. Install horizontal bridging in stud system, spaced vertically as indicated on Shop Drawings Insert dimension. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches deep.

2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges, and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

J. Install steel sheet diagonal bracing straps to both stud flanges; terminate at and fasten to reinforced top and bottom tracks. Fasten clip-angle connectors to multiple studs at ends of bracing and anchor to structure.

K. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.4 INSTALLATION OF EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: As indicated on Project Plans.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
2. Install double deep-leg deflection tracks and anchor outer track to building structure.
3. Connect vertical deflection clips to studs and anchor to building structure.
4. Connect drift clips to cold-formed steel framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 INSTALLATION OF INTERIOR NON-LOAD-BEARING WALL FRAMING

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: As indicated on Project Plans.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
2. Install double deep-leg deflection tracks and anchor outer track to building structure.
3. Connect vertical deflection clips to studs and anchor to building structure.
4. Connect drift clips to cold-formed steel metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.6 INSTALLATION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.7 REPAIRS

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

3.8 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform special inspections as indicated in Specification 014535 “Code-Required Special Inspections and Procedures” and on the project plans.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Engineer.

D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

END OF SECTION 054000

SECTION 054400 - COLD-FORMED METAL TRUSSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof trusses.
2. Floor trusses.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Cold-formed steel truss materials.
2. Anchor bolts.
3. Post-installed anchors.
4. Power-actuated fasteners.
5. Mechanical fasteners.

B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel trusses; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Delegated-Design Submittal: For cold-formed steel trusses.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product test reports.

C. Research Reports: For post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Aegis Metal Framing.
2. MarinoWARE.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel trusses.

B. Structural Performance: Provide cold-formed steel trusses capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated on Drawings.
2. Deflection Limits: Design trusses to withstand design loads without deflections greater than the following:

a. Floor Trusses: Vertical deflection of 1/480 for live loads and l/360 for total loads of the span.
b. Roof Trusses: Vertical deflection of 1/240 of the span.

3. Design trusses to provide for movement of truss members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.

C. Cold-Formed Steel Truss Standards: Unless more stringent requirements are indicated, trusses shall comply with the following:

1. Floor and Roof Systems: AISI S210.
2. Lateral Design: AISI S213.
3. Roof Trusses: AISI S214.

D. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.3 COLD-FORMED STEEL TRUSS MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:

1. Grade: ST50H.
2. Coating: G60, A60, AZ50, or GF30.

2.4 ROOF TRUSSES

A. Roof Truss Members: Manufacturer's standard steel sections.

1. Connecting Flange Width: 1-5/8 inches, minimum at top and bottom chords connecting to sheathing or other directly fastened construction.
2. Minimum Base-Metal Thickness: 0.0329 inch.

2.5 TRUSS ACCESSORIES

A. Fabricate steel-truss accessories from steel sheet, ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for truss members.

B. Provide accessories of manufacturer's standard thickness and configuration unless otherwise indicated.

2.6 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.

B. Anchor Bolts: ASTM F1554, Grade 36, threaded carbon-steel, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153/A153M, Class C.

C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58, or ICC-ES AC308 as appropriate for the substrate.

1. Uses: Securing cold-formed steel trusses to structure.
2. Type: Torque-controlled expansion anchor or adhesive anchor.
3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.

4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F593, and nuts, ASTM F594.

D. Power-Actuated Fasteners: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.

1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

2.7 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A780/A780M or SSPC-Paint 20.

B. Shims: Load-bearing, high-density multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as truss members supported by shims.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install bridge, and brace cold-formed steel trusses according to AISI S200, AISI S202, AISI S214, and manufacturer's written instructions unless more stringent requirements are indicated.

1. Coordinate with wall framing to align webs of bottom chords and load-bearing studs or continuously reinforce track to transfer loads to structure.
2. Install continuous bridging and permanently brace trusses as indicated on Shop Drawings and designed according to CFSEI's Technical Note 551e, "Design Guide: Permanent Bracing of Cold-Formed Steel Trusses."

B. Install cold-formed steel trusses and accessories true to line and location, and with connections securely fastened.

C. Install temporary bracing and supports to secure trusses and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to trusses are secured.

D. Truss Spacing: As indicated on Drawings.

3.2 ERECTION TOLERANCES

A. Install cold-formed steel trusses level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual trusses no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.3 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel trusses with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform special inspections as indicated on Specification 014535 “Code-Required Special Inspections and Procedures” and on the project plans.

B. Cold-formed metal trusses will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 054400

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Miscellaneous steel framing and supports.
2. Shelf angles.
3. Metal ladders.
4. Metal Ship ladders.
5. Metal floor plate and supports.
6. Structural-steel door frames.
7. Miscellaneous steel trim.
8. Metal bollards.
9. Loose bearing and leveling plates.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Paint products.
2. Grout.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

C. Delegated-Design Submittal: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders and staircases.

B. Structural Performance of Aluminum Ladders: Aluminum ladders, including landings, shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Stainless-Steel Bars and Shapes: ASTM A276, Type 304.

D. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

E. Rolled-Stainless-Steel Floor Plate: ASTM A793.

F. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.

G. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.

H. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

1. Size of Channels: 1-5/8 by 1-5/8 inches, or as indicated on the plans.
2. Material: Galvanized steel, ASTM A653/A653M, structural steel, Grade 33, with G90 coating; 0.079-inch nominal thickness.
3. Material: Cold-rolled steel, ASTM A1008/A1008M, structural steel, Grade 33; 0.0677-inch minimum thickness; coated with rust-inhibitive, baked-on, acrylic enamel, or hot-dip galvanized after fabrication.

I. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

J. Aluminum Extrusions: ASTM B221, Alloy 6063-T6.

K. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.

L. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

M. Nickel Silver Castings: ASTM B584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.
2. Provide stainless-steel fasteners for fastening stainless steel.
3. Provide stainless-steel fasteners for fastening nickel silver.
4. Provide bronze fasteners for fastening bronze.

B. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329.

C. Post-Installed Anchors: Torque-controlled expansion anchors or epoxy anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F593, and nuts, ASTM F594.

D. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting," Section 099123 Interior Painting,"

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

F. Non-shrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

G. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.

C. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended.

D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Locate joints where least conspicuous.

E. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors not less than 8 inches from ends and corners of units and 24 inches o.c.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

C. Fabricate steel girders for wood frame construction from continuous steel shapes of sizes indicated.

1. Where wood nailers are attached to girders with bolts or lag screws, drill or punch holes at 16 inches o.c.

D. Fabricate steel pipe columns for supporting wood frame construction from steel pipe with steel baseplates and top plates as indicated. Drill or punch baseplates and top plates for anchor and connection bolts and weld to pipe with fillet welds all around. Make welds the same size as pipe wall thickness unless otherwise indicated.

2.7 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.

C. Galvanize and prime shelf angles located in exterior walls.

D. Prime shelf angles located in exterior walls with primer specified in Section 099113 “Exterior Painting.”

E. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.8 METAL LADDERS

A. General:

1. Comply with ANSI A14.3, except for elevator pit ladders.

B. Steel Ladders:

1. Space side rails 18 inches apart unless otherwise indicated.
2. Siderails: Continuous, 1/2-by-2-1/2-inch steel flat bars, with eased edges.
3. Rungs: 3/4-inch-diameter or 3/4-inch-square steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung.
6. Galvanize and prime exterior ladders, including brackets.
7. Prime paint all ladders, including brackets and fasteners, with primer specified in Section 099113 “Exterior Painting.”

2.9 METAL SHIP LADDERS

A. General:

1. Comply with IBC Section 1011.15.

B. Steel Ship Ladders:

1. Treads to have a minimum depth of 5”
2. Risers to have a minimum height of 9 ½”
3. Handrails to be provided on both sides.
4. The minimum clear width at handrails shall be 20.”
5. Provide nonslip surfaces on all treads and platforms.
6. Galvanize and prime exterior ladders, including brackets.
7. Prime paint ladders, including brackets and fasteners, with primer specified in Section 099113 “Exterior Painting.”

2.10 METAL FLOOR PLATE

A. Fabricate from rolled-steel floor plate of thickness indicated below:

1. Thickness: 1/8 inch.

B. Provide steel angle supports as indicated.

C. Provide flush steel bar drop handles for lifting removable sections, one at each end of each section.

2.11 STRUCTURAL-STEEL DOOR FRAMES

A. Fabricate structural-steel door frames from steel shapes, plates, and bars of size and to dimensions indicated, fully welded together, with 5/8-by-1-1/2-inch steel channel stops. Plug-weld built-up members and continuously weld exposed joints. Reinforce frames and drill and tap as necessary to accept finish hardware.

1. Provide with integrally welded steel strap anchors for securing door frames into adjoining concrete or masonry.

B. Galvanize exterior steel frames.

C. Prime steel frames with primer specified in Section 099113 “Exterior Painting.”

2.12 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

C. Galvanize exterior miscellaneous steel trim.

D. Prime miscellaneous steel trim with primer specified in Section 099113 “Exterior Painting.”

2.13 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 40 steel pipe or steel shapes, as indicated on plans.

1. If bollards are not indicated to be concrete filled, cap bollards with 1/4-inch-thick steel plate.

B. Fabricate sleeves for bollard anchorage from steel pipe or tubing with 1/4-inch-thick steel plate welded to bottom of sleeve.

C. Prime bollards with primer specified in Section 099113 “Exterior Painting.”

2.14 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

2.15 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated.

B. Galvanize loose steel lintels located in exterior walls.

C. Prime loose steel lintels located in exterior walls with primer specified in Section 099113 “Exterior Painting.”

2.16 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.17 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

2.18 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

B. Shop prime iron and steel items unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with primers specified in Section 099113 "Exterior Painting" primers or specified in Section 099123 "Interior Painting.”

C. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Items Indicated to Receive Primers Specified in Section 099113 “Exterior Painting”: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
4. Other Items: SSPC-SP 3, "Power Tool Cleaning."

D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING METAL BOLLARDS

A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installation, unless otherwise indicated.

B. Anchor bollards in concrete with pipe sleeves preset and anchored into concrete. Fill annular space around bollard solidly with non-shrink grout.

C. Anchor bollards in place with concrete footings. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

D. Fill bollards solidly with concrete, mounding top surface to shed water.

3.3 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with non-shrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055000

SECTION 055119 - METAL GRATING STAIRS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Industrial Class stairs with steel-grating treads.
2. Aluminum railings and guards attached to metal stairs.
3. Aluminum handrails attached to walls adjacent to metal stairs.
4. Ship ladder with steel grating treads.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

1.3 ACTION SUBMITTALS

A. Product Data: For metal grating stairs and the following:

1. Gratings.
2. Woven-wire mesh.
3. Welded-wire mesh.
4. Shop primer products.
5. Grout.

B. Shop Drawings:

1. Include plans, elevations, sections, details, and attachment to other work.
2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
3. Include plan at each level.
4. Indicate locations of anchors, weld plates, and blocking for attachment of wall-mounted handrails.

C. Delegated-Design Submittal: For stairs, railings, and guards, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the State in which Project is located.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stairs, railings, and guards, including attachment to building construction.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft..
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing and guard loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/360.

C. Structural Performance of Railings and Guards: Railings and guards, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
b. Infill load and other loads need not be assumed to act concurrently.

3. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
a. Temperature Change: 120 deg F, ambient.

D. Seismic Performance of Stairs: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 METALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

C. Steel Bars for Grating Treads: ASTM A36/A36M or steel strip, ASTM A1011/A1011M or ASTM A1018/A1018M.

D. Steel Wire Rod for Grating Crossbars: ASTM A510/A510M.

E. Aluminum Bars for Grating Treads: ASTM B221 extruded aluminum alloys as follows:

1. 6061-T6 or 6063-T6, for bearing bars of gratings and shapes.
2. 6061-T1, for grating crossbars.

F. Steel Tubing for Railings and Guards: ASTM A513/A513M.

1. Provide galvanized finish for exterior installations and where indicated.

G. Steel Pipe for Railings and Guards: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

H. Provide galvanized finish for exterior installations and where indicated.

I. Woven-Wire Mesh: Intermediate-crimp, diamond pattern, 2-inch woven-wire mesh, made from 0.135-inch nominal-diameter steel wire complying with ASTM A510/A510M.

J. Welded-Wire Mesh: Diamond pattern, 2-inch welded-wire mesh, made from 0.236-inch nominal-diameter steel wire complying with ASTM A510/A510M.

K. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

L. Cast-Abrasive Nosings: Cast iron, with an integral abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both.

2.3 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls.

1. Select fasteners for type, grade, and class required.

B. Fasteners for Anchoring Railings and Guards to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings and guards to other types of construction indicated and capable of withstanding design loads.

C. Post-Installed Anchors: Torque-controlled expansion anchors or epoxy anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 Group 2 stainless-steel bolts, ASTM F593, and nuts, ASTM F594.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting," Section 099123 "Interior Painting,"

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Zinc-Rich Primer: Comply with SSPC-Paint 20, Type I-A, Level 1, and compatible with topcoat.

D. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

E. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 ASTM A780/A780M and compatible with paints specified to be used over it.

F. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout; recommended by manufacturer for interior or exterior use as applicable; noncorrosive and nonstaining; mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, railings, guards, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.

B. Assemble stairs, railings, and guards in shop to greatest extent possible.

1. Disassemble units only as necessary for shipping and handling limitations.
2. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
2. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish # 3 - Partially dressed weld with spatter removed.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.

1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
2. Locate joints where least conspicuous.
3. Fabricate joints that are exposed to weather in a manner to exclude water.
4. Provide weep holes where water may accumulate internally.

2.6 FABRICATION OF STEEL-FRAMED STAIRS AND SHIP LADDERS

A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Industrial Class, unless more stringent requirements are indicated.

B. Stair Framing:

1. Fabricate stringers of steel plates or channels.

a. Stringer Size: As required to comply with "Performance Requirements" Article.
b. Provide closures for exposed ends of channel stringers.
c. Finish: Shop primed, Painted, and Galvanized.

2. Construct platforms and tread supports of steel plate or channel headers and miscellaneous framing members as required to comply with "Performance Requirements" Article.

a. Provide closures for exposed ends of channel framing.
b. Finish: Shop primed, Painted, and Galvanized.

3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers.

4. Where stairs are enclosed by gypsum board shaft-wall assemblies, provide hanger rods or struts to support landings from floor construction above or below.

    a. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.

5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

C. Metal Bar-Grating Stairs: Form treads and platforms to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."

1. Fabricate treads and platforms from welded steel grating with 1-1/4-by-3/16-inch bearing bars at 15/16-inch o.c. and crossbars at 4 inches o.c.
2. Fabricate treads and platforms from welded steel grating with openings in gratings no more than 1 inch in least dimension.

    a. Surface: Plain. Use Serrated in wet conditions or outdoors.
    b. Finish: Shop primed, Painted, and Galvanized.

3. Fabricate grating treads with rolled-steel floor plate nosing and with steel angle or steel plate carrier at each end for stringer connections.

    a. Secure treads to stringers with bolts.

4. Fabricate grating platforms with nosing matching that on grating treads.

    a. Secure grating to platform framing by welding with bolts.

D. Risers: Open.

E. Toe Plates: Provide toe plates around openings and at edge of open-sided floors and platforms, and at open ends and open back edges of treads.

1. Material and Finish: Steel plate to match finish of other steel items.
2. Fabricate to dimensions and details indicated.

2.7 FABRICATION OF STAIR RAILINGS AND GUARDS

A. Comply with applicable requirements in Section 055213 "Pipe and Tube Railings."

B. Fabricate railings and guards to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of member, post spacings, wall bracket spacing, and anchorage, but not less than that needed to withstand indicated loads.

1. Rails and Posts: 1-1/2-inch-square top and bottom rails and 1-1/2-inch-square posts.
2. Picket Infill: 1/2-inch- square pickets spaced to prohibit the passage of a 4-inch diameter sphere.
3. Mesh Infill: Welded-wire mesh welded into 1-by-1/2-by-1/8-inch steel channel frames. Orient wire mesh with diamonds vertically.

4. Intermediate Rails Infill: 1-1/2-inch-square intermediate rails spaced less than 12 inches clear.

C. Welded Connections: Fabricate railings and guards with welded connections.

1. Fabricate connections that are exposed to weather in a manner that excludes water.

a. Provide weep holes where water may accumulate internally.

2. Cope components at connections to provide close fit, or use fittings designed for this purpose.
3. Weld all around at connections, including at fittings.
4. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
5. Obtain fusion without undercut or overlap.
6. Remove flux immediately.
7. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #3 - Partially dressed weld with spatter removed as shown in NAAMM AMP 521.

D. Form changes in direction of railings and guards as follows:

1. As detailed.
2. By bending or by inserting prefabricated elbow fittings.
3. By flush bends or by inserting prefabricated flush-elbow fittings.
4. By radius bends of radius indicated or by inserting prefabricated elbow fittings of radius indicated.
5. By inserting prefabricated flush-elbow fittings.

E. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required.

1. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

F. Close exposed ends of railing and guard members with prefabricated end fittings.

G. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.

1. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

H. Connect posts to stair stringers by bolting. Separate dissimilar metals with bitumastic coating or neoprene.

I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.

1. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.
2. For galvanized railings and guards, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.

3. For nongalvanized railings and guards, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanized anchors embedded in exterior masonry and concrete construction.
4. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

J. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports.

1. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.8 FINISHES

A. Finish metal stairs after assembly.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
2. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

1. Exterior Stairs: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Interior Stairs: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Interior Stairs: SSPC-SP 3, "Power Tool Cleaning."

D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION OF METAL STAIRS & SHIPS LADDER

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.

1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

1. Grouted Baseplates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces.

a. Clean bottom surface of baseplates.
b. Set steel-stair baseplates on wedges, shims, or leveling nuts.
c. After stairs have been positioned and aligned, tighten anchor bolts.
d. Do not remove wedges or shims, but if protruding, cut off flush with edge of bearing plate before packing with grout.
e. Promptly pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

1) Neatly finish exposed surfaces; protect grout and allow to cure.
2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
3. Comply with requirements for welding in "Fabrication, General" Article.

3.2 INSTALLATION OF RAILINGS AND GUARDS

A. Adjust railing and guard systems before anchoring to ensure matching alignment at abutting joints with tight, hairline joints.

1. Space posts at spacing indicated or, if not indicated, as required by design loads.
2. Plumb posts in each direction, within a tolerance of 1/16 inch in 3 feet.
3. Align rails and guards so variations from level for horizontal members and variations from parallel with rake of stairs for sloping members do not exceed 1/4 inch in 12 feet.
4. Secure posts, rail ends, and guard ends to building construction as follows:

a. Anchor posts to steel by welding or bolting to steel supporting members.
b. Anchor handrail and guard ends to concrete and masonry with steel round flanges welded to rail and guard ends and anchored with post-installed anchors and bolts.

B. Attach handrails to wall with wall brackets.

1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
2. Secure wall brackets to building construction as required to comply with performance requirements.

3.3 REPAIR

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting,"

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055119

SECTION 055210 – ALUMINUM HANDRAILS

PART 1 - GENERAL

1.1 SCOPE:

A. Supply all materials, labor, and equipment necessary to provide aluminum handrail assembled and installed complete as specified herein and detailed in project drawings.

1.2 DESCRIPTION:

A. Aluminum handrails to be smooth and continuous, free of burrs and protrusions, assembled by means of mechanical fittings. No pop rivets, sheet metal screws, self-tapping screws, epoxies, or welded connections will be accepted

1.3 PRODUCT DATA:

A. Supply all related technical data on the handrail system including: catalogs, material compliance sheets, and material safety data sheets.

1.4 SAMPLES:

A. Supply a railing sample complete with top and mid-rails, multiple posts, toe plate and toe plate attachment as well as base mounting system if required by project drawings.

1.5 SHOP DRAWINGS:

A. Prior to fabrication of the handrail, shop drawings shall be submitted which include the following: plans showing location of handrail required for the project with all necessary dimensions, and detail drawings which show standard handrail elevations, typical railing connections, anchoring systems, and expansion joints.

PART 2 – PRODUCTS

2.1 MANUFACTURER:

A. Pleasant Mount Welding, Inc. Handrail System (Carbondale, PA) using Interna-Rail fittings supplied by Hollaender Mfg. Co.

B. Or Approved Equal.

2.2 PERFORMANCE:

A. All railings shall be supplied to conform to applicable sections of the following building codes:

1. CFR 1910.29 (OSHA)

2. International Building Code (IBC)

2.3 COMPONENTS:

A. The handrail shall be made of pipes joined together with component fittings. Components that are pop-riveted or glued at the joints will not be acceptable. All components must be mechanically fastened with stainless steel hardware.

B. Railings shall be 1½ ” Schedule 40 aluminum pipe alloy 6063-T6, ASTM-B-429 or ASTM-B-221. Posts shall be 1½” Schedule 80 aluminum pipe. Post spacing shall be a maximum of 8’0”-meeting OSHA standards.

C. Railing shall be shop assembled in lengths not to exceed 24 feet for field erection. Guardrails and Handrails shall be designed to withstand a 200 lb concentrated load applied in any direction and at any point on the top rail.

D. Intermediate railings shall be provided such that a 21-inch diameter sphere cannot pass through any opening.

E. Posts shall not interrupt the continuation of the top rail at any point along the railing, including corners and end terminations (OSHA 1910.23). The top surface of the top railing shall be smooth and shall not be interrupted by projected fittings.

F. The Mid-rail at a corner return shall be able to withstand a 200 lb load without loosening. The manufacturer is to determine this dimension for their system and provide physical tests from a laboratory to confirm compliance. Concrete anchors shall be stainless steel type 316 or 304 wedge anchors and shall be furnished by the handrail manufacturer. The anchor design shall include the appropriate reduction factors for spacing and edge distances in accordance with the manufacturers published data.

G. Toeboard shall conform to OSHA standards. Toeboard shall be a minimum of 4” high and shall be an extrusion that attaches to the posts with clamps that will allow for expansion and contraction between posts. Toeboard shall be set ¼” above the walking surface. Toeboard shall be provided on handrails as required by OSHA and/or shown on drawings. Toeboard shall be shipped in stock lengths for field installation.

H. Finish shall be Aluminum Association M10-C22-A41 (215-R10).

I. Aluminum surfaces in contact with concrete, grout or dissimilar metals shall be protected with a coat of bituminous paint.

J. The manufacturer shall submit calculations for approval at the request of the Engineer. Calculations shall be prepared and sealed by a New York State licensed Professional Engineer.

K. Guardrails and Handrails shall be designed to withstand a 200 lb Concentrated load applied in any direction and at any point on the top rail. Guardrails and Handrails shall also be designed to withstand a uniform load of 50 lb/ft applied horizontally to the top rail. Uniform loads are not to be applied simultaneously with the concentrated loads.

PART 3 – EXECUTION

3.1 FABRICATION:

A. Handrails shall be fabricated based on site dimensions supplied by the contractor. All handrail sections shall be straight and true with no visible gaps in connections. If core mounted, posts shall be supplied the proper length for 6" embedment with 1/4" diameter weep hole located 1/4" above the walking surface and coated with 6" of bituminous mastic.

3.2 INSTALLATION:

A. Handrails shall be installed in strict accordance with the manufacturer's instructions. Once installed all handrails shall be in compliance with the requirements of the aforementioned building codes.

3.3 CLEANING:

A. Remove all stains, dirt, grease, or other substances by washing all railings thoroughly using clean water and soap; rinse with clean water. Do not use acid solutions, steel wool and other harsh abrasives. Remove any material which is permanently stained as well as damaged.

3.4 EXPANSION AND CONTRACTION:

A. Allow for expansion and contraction in top rail by means of a splice at a maximum of 24' intervals.

B. Allow for expansion and contraction in toe board by providing mounting brackets which permit movement of the toe board. When installed, toe board should have a sufficient gap when splicing sections to allow for movement.

END OF SECTION 055210

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel pipe and tube railings.
2. Aluminum pipe and tube railings.

B. Related Requirements:

1. Section 055119 "Metal Grating Stairs" for steel tube railings associated with metal stairs.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings.
2. Railing brackets.
3. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed finish required.

D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E894 and ASTM E935.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Steel Pipe and Tube Railings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Hollaender Mfg. Co.
b. R & B Wagner, Inc.
c. Tuttle, a Dant Clayton Division.

B. Aluminum Pipe and Tube Railings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Blum, Julius & Co., Inc.
b. Hollaender Mfg. Co.
c. R & B Wagner, Inc.
d. Superior Aluminum Products, Inc.
e. Tri Tech, Inc.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
b. Infill load and other loads need not be assumed to act concurrently.

2.3 METALS, GENERAL

A. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

2.4 STEEL AND IRON

A. Tubing: ASTM A500 (cold formed) or ASTM A513.

B. Pipe: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

1. Provide galvanized finish for exterior installations and where indicated.

C. Plates, Shapes, and Bars: ASTM A36/A36M.

D. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

E. Expanded Metal: ASTM F1267, Type I (expanded), Class 1 (uncoated).

1. Style Designation: 3/4 number 13.

F. Perforated Metal: Cold-rolled steel sheet, ASTM A1008/A1008M, or hot-rolled steel sheet, ASTM A1011/A1011M, commercial steel Type B, 0.060 inch thick, with 1/4-inch holes 3/8 inch o.c. in staggered rows.

1. Basis-of-Design Product: Provide product with perforations matching R&B Wagner.

G. Woven-Wire Mesh: Intermediate-crimp, diamond pattern, 2-inch woven-wire mesh, made from 0.134-inch-diameter wire complying with ASTM A510.

2.5 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

B. Extruded Bars and Tubing: ASTM B221, Alloy 6063-T5/T52.

C. Extruded Structural Pipe and Round Tubing: ASTM B429/B429M, Alloy 6063-T6.

D. Drawn Seamless Tubing: ASTM B210, Alloy 6063-T832.

E. Plate and Sheet: ASTM B209, Alloy 6061-T6.

F. Die and Hand Forgings: ASTM B247, Alloy 6061-T6.

G. Castings: ASTM B26/B26M, Alloy A356.0-T6.

H. Perforated Metal: Aluminum sheet, ASTM B209, Alloy 6061-T6, 0.063 inch thick, with 1/4-inch holes 3/8 inch o.c. in staggered rows.
1. Basis-of-Design Product: Provide product with perforations matching Blum, Julius & Co., Inc.

I. Woven-Wire Mesh: Intermediate-crimp, diamond pattern, 2-inch woven-wire mesh, made from 0.162-inch-diameter wire complying with ASTM B211, Alloy 6061-T94.

2.6 FASTENERS

A. General: Provide the following:

1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B633 or ASTM F1941, Class Fe/Zn 5 for zinc coating.
2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A153/A153M or ASTM F2329 for zinc coating.
3. Aluminum Railings: Type 304 stainless-steel fasteners.
4. Stainless-Steel Railings: Type 304 stainless-steel fasteners.

B. Post-Installed Anchors: Torque-controlled expansion anchors or epoxy anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E488/E488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F593, and nuts, ASTM F594.

2.7 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting," Section 099123 "Interior Painting."

E. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

F. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

G. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

H. Epoxy Intermediate Coat: Complying with MPI #77 and compatible with primer and topcoat.

I. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.

J. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

K. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.8 FABRICATION

A. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

B. Form work true to line and level with accurate angles and surfaces.

C. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

D. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

E. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

F. Form changes in direction by bending or by inserting prefabricated elbow fittings.

G. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

H. Close exposed ends of railing members with prefabricated end fittings.

I. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.

J. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

K. Expanded-Metal Infill Panels: Fabricate infill panels from expanded metal made from same metal as railings in which they are installed.

1. Orient expanded metal with long dimension of diamonds parallel to top rail.

L. Perforated-Metal Infill Panels: Fabricate infill panels from perforated metal made from same metal as railings in which they are installed.

1. Orient perforated metal with pattern parallel to top rail.

M. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into 1-by-1/2-by-1/8-inch metal channel frames. Make wire mesh and frames from same metal as railings in which they are installed.

1. Orient wire mesh with wires perpendicular and parallel to top rail.

2.9 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
2. Comply with ASTM A123/A123M for hot-dip galvanized railings.
3. Comply with ASTM A153/A153M for hot-dip galvanized hardware.

B. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

D. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Do not apply primer to galvanized surfaces.

E. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Apply at spreading rates recommended by coating manufacturer.

1. Color: As selected by Architect from manufacturer's full range.

2.10 ALUMINUM FINISHES

A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Mill Finish: AA-M12, nonspecular as fabricated.

C. Clear Anodic Finish: AAMA 611.

D. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

3.2 ANCHORING POSTS

A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members.

3.3 ATTACHING RAILINGS

A. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

B. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.

4. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055213

SECTION 055901-STANDARD-DUTY ALUMINUM INTERLOCKING FLAT PANEL TANK COVER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Provide aluminum covers, support members and appurtenances as indicated and specified.

2. Aluminum covers shall be the product of one manufacturer.

1.2 REFERENCE STANDARDS

A. ASTM B221: Aluminum Extruded Bars and Shapes.

B. ASTM F593: Standard Specifications for Stainless Steel Bolts, Hex Cap Screws and Studs.

C. ASTM F594: Standard Specification for Stainless Steel Nuts.

1.3 SEISMIC DESIGN REQUIREMENTS

A. The Contractor shall conform to the seismic design requirements for this project and for the work of this specification section.

1.4 ACTION SUBMITTALS

A. Shop Drawings: The contractor shall submit shop drawings to the Engineer for approval for the fabrication of all Aluminum Covers based on construction drawings of current issue. The drawings shall be approved and released to the shop before fabrication of the covers. Include plans, sections, shop details, and connections as required by the contract documents. Show type and location of all fasteners. Preliminary drawings shall be stamped by the cover manufacturer's PE. Final drawings shall be signed and sealed by a local state PE if required by contract documents. All work shall be fabricated and erected in accordance with the approved shop drawings.

B. Stress Analysis: Prior to executing any work in this section, complete structural calculations showing the load criteria and governing stresses in all members and connections shall be submitted to the Engineer for approval. These calculations shall be signed and sealed by a registered professional engineer licensed in New York State. All work shall be fabricated and erected in accordance with the approved structural calculations.

1. Design loads are provided on the project plans.

1.5 QUALITY ASSURANCE

A. The Standard-Duty Aluminum Interlocking Flat Panel Covers, as specified, shall be the product of a single manufacturer regularly engaged in the design and manufacture of engineered aluminum covers. When requested by the Engineer, submit written evidence to show experience qualifications and facility capabilities for performance of contract requirements.

B. Welders: Welders performing work on the Standard-Duty Aluminum Interlocking Covers shall be qualified within the past two years in accordance with AWS.

C. Warranty: Provide a two (2) year warranty from material and workmanship defects.

1.6 OPERATION & MAINTENANCE MANUAL

A. The cover manufacturer shall provide an O&M Manual that includes maintenance instructions, removal and replacement instructions, and drawings for the installed cover.

PART 2 - PRODUCTS

2.1 SOURCE REQUIREMENTS

A. Design is based upon use of aluminum covers as manufactured by Pleasant Mount Welding, Inc. and terminology used herein may include reference to the specific performance or product of this manufacturer. Such reference shall be construed only as establishing the quality of materials, operational features and workmanship used under this section and shall not, in any way, be construed as limiting competition.

2.2 MANUFACTURERS

A. Acceptable manufacturers include Pleasant Mount Welding, Inc. (45 Dundaff Street, Carbondale, PA 18407, 570-282-6164, www.pmwi.net) or approved equal.

2.3 MANUFACTURED UNITS

A. Description**:** Standard-Duty Aluminum Interlocking Flat Panel Covers consisting of removable hinged and non-hinged cover panels, interlock beams with stiffening support members (if required), and associated anchorage fasteners.

1. **Cover Decking**: Extruded aluminum double-interlocking planks.
2. **Support Beam**: Extruded aluminum interlock beam with stiffening structural support members to meet specified loading/span requirements.
3. **Cover Panel Type**: Aluminum cover panels may be configured **hinged or non-hinged** as layout and tank access requires.
4. All cover panels shall be removable and capable of being removed without disruption of adjacent panels.
5. **Locking Mechanism**: Each cover panel shall use extruded slide latch assemblies to resist uplift and secure covers to interlock beams.
6. **Top Surface of Cover**: Slip Resistance Striations **with SlipNOT® Slip Resistance Coating**. The cover surface shall consist of integral slip resistance striations to prevent slipping and no exposed area of the cover wider than 1.75” shall be without striations. This surface shall not be achieved by the use of paint, adhesive tapes, sand blasting, or any other means other than an extruded process.
7. The clear span length and width of cover panels shall be as noted in the contract documents.
8. The weight of an individual cover panel shall not exceed 150 pounds. The lifting force shall not exceed the dead weight of the panel.
9. Covers shall allow for thermal expansion and contraction.
10. Cover Mounting Configuration: **Top mount or Flush Mount** arrangement, as indicated on the plans.

B. Fabrication: Fabricate aluminum covers to required manufacturer’s specifications and contract drawings.

C. Design Criteria:

1. Distributed Design Live Load & Deflection: All structural components shall be designed to support the dead weight of the structure, plus a live load of 50 pounds per square foot of cover surface. The maximum deflection of any component under this load shall not exceed L/240 of the span of that component.
2. Concentrated Load: All structural components shall be designed to support a 400 pound load on a 6" x 6" area located anywhere on the surface of the cover without permanently deforming the tested area.
3. Design Stresses: All aluminum structural members and connections shall be designed in accordance with the Aluminum Association's "Specification for Aluminum Structures" for building-type structures.
4. Chemical Resistance: Aluminum cover panels and interlock beams shall be comprised entirely of 6061-T6 corrosion resistant aluminum extrusions and any required stiffening support members shall also be 6061-T6 aluminum. Replaceable Santoprene™ seals shall isolate the cover perimeter from the concrete and at every panel-to-panel interface to ensure a significantly air-tight cover.

D. Materials: All aluminum cover decking components, interlock beams, and stiffening support members shall be made from 6061-T6 corrosion resistant aluminum of sufficient section modulus and moment of inertia to withstand the design loads. Material shall be of top quality.

E. Welding Electrodes: Welding shall be with electrodes of an alloy, which shall produce welds with strength and corrosion resistance compatible to base material.

F. Fasteners: All fasteners used to attach aluminum cover system to concrete shall be stainless steel. No carbon steel accessories shall be used.

G. Finish: Aluminum covers shall be mill finish.

2.4 ACCESSORIES

A. Provide appropriate fasteners for type, grade, and class required for approved anchorage system in accordance with the approved shop drawings and specifications.

PART 3 - TESTING

3.1 LOADS

A. After installation the cover system will be tested for conformance with the deflection limits. A load of 400 pounds will be placed as directed by the Engineer and the maximum deflection created by the load will be measured.

3.2 PREQUALIFIED SHOP TESTING

A. Manufacturer shall perform a prequalified shop air tightness test and certification for the proposed cover system. This test shall be performed in accordance with the "Procedural Standards for Testing, Adjusting and Balancing of Environment System" as published by the National Environmental Balancing Bureau (NEBB) on cover components of not less than 80 square feet. The test shall be conducted and witnessed by a NEBB certified technician. The method of testing, test apparatus and proposed contents of the test report shall be submitted to the Engineer for approval. The test report shall be prepared by the certified technician and shall be sealed with the NEBB seal. The test report shall include descriptions and illustrations of the test components, test apparatus and will contain the results of the test. The cover system shall

maintain an air intrusion leakage rate not to exceed 0.2 cfm per square foot at an applied negative pressure of 0.2 inches of water column.

PART 4 - EXECUTION

4.1 FIELD VERIFICATION

A. Take field measurements prior to preparation of final shop drawings (and fabrication where required) to ensure proper fitting of the work.

4.2 INSTALLATION

A. Prior to aluminum cover installation, contractor shall inspect supporting structure (concrete and any other support locations) to confirm correct elevations and conditions for proper attachment and support of the cover. Any inconsistencies between contract drawings and supporting structure deemed detrimental to cover placement shall be reported in writing to the engineer, architect or owner's agent prior to placement.

B. Install aluminum cover in accordance with approved shop drawings and specifications.

C. Protection of Aluminum from Dissimilar Materials:
   1. Where aluminum surfaces come into contact with dissimilar metals, surfaces shall be kept from direct contact by painting the dissimilar metal with one coat of bituminous paint, powder coat paint, or other approved insulating material.
   2. Where aluminum surfaces come into contact with dissimilar materials such as concrete, masonry or lime mortar, exposed aluminum surfaces shall be painted with one coat of bituminous paint, powder coat paint, or other approved insulating material.

4.3 COVER ATTACHMENT

A. Use approved attachment system and fasteners to secure aluminum covers to supporting members as shown on approved drawings.

END OF SECTION 055901

SECTION 055902 - HEAVY-DUTY PLANK ALUMINUM FLAT PANEL COVER

PART 1 - GENERAL

1.1 PURPOSE:

A. This specification establishes the minimum criteria for the design, fabrication, and erection of Heavy-Duty Plank Aluminum Flat Panel Covers comprised of hinged and fixed panels and the associated support beams and shelf angles as manufactured by Pleasant Mount Welding, Inc. (Carbondale, Pennsylvania).

1.2 SCOPE OF WORK:

A. Provide all labor, materials, and equipment required to supply a complete system of removable Heavy-Duty Plank aluminum flat panel covers. The Heavy-Duty Plank Aluminum Flat Panel Cover includes cover panels, structural supports (Structural Beams and Shelf Angles), and attaching hardware.

PART 2 - ENGINEERING & ACTION SUBMITTALS

2.1 SHOP DRAWINGS:

A. The contractor shall submit the shop drawings to the Engineer of Record (EOR) for approval for the fabrication of the Heavy-Duty Plank Aluminum Flat Panel Cover system based on construction drawings of current issue. The drawings shall be approved and released to the shop before fabrication of the panels. Include plans, sections, shop details, and connections as required by the contract documents.

PART 3 - QUALIFICATIONS

3.1 MANUFACTURER:
Pleasant Mount Welding, Inc.
45 Dundaff Street, Carbondale, Pennsylvania 18407
Phone: (570) 282-6164 Fax: (570) 282-7917
Email: sales@pmwi.net Website: https://www.pmwi.net

3.2 The Heavy-Duty Plank Aluminum Flat Panel Covers, as specified, shall be the product of a single manufacturer regularly engaged in the design, manufacture, and installation of engineered aluminum covers.

3.3 WELDERS:

Welders performing work on the Heavy-Duty Plank Aluminum Flat Panel Covers shall be qualified within the past two years in accordance with AWS.

PART 4 – PERFORMANCE & DESIGN

4.1 SPAN:

A. The clear span length of the cover shall be as indicated on the project plans.

4.2 WIDTH:

A. The width of the cover shall be as indicated on the project plans.

4.3 DISTRIBUTED DESIGN LIVE LOAD & DEFLECTION:

A. All structural components shall be designed to support the load indicated on the project plans. The maximum deflection of any component shall not exceed L/240 of the span of that component.

4.4 CONCENTRATED LOAD:

A. All structural components shall be designed to support a 300 LB concentrated load anywhere on the surface of cover without permanently deforming the test area.

4.5 DESIGN STRESSES:

A. All aluminum structural members and connections shall be designed in accordance with the Aluminum Association's "Specification for Aluminum Structures" for building-type structures.

4.6 SLIP RESISTANCE:

A. The Heavy-Duty Plank Aluminum Flat Panel Cover shall have a non-skid surface and no exposed area of the cover system wider than one inch shall be without striations/non-skid surface. The Pleasant Mount Welding, Inc. aluminum cover's Heavy-Duty Plank Cover decking is ribbed with concave and convex striations to prevent slipping and to assist in the removal of water off the covers' surface. This surface shall not be achieved by the use of paint, adhesive tapes, sand blasting, or any other means other than the extruded process.

4.7 CHEMICAL RESISTANCE:

A. The Heavy-Duty Plank Aluminum Flat Panels shall be composed entirely of 6061-T6 corrosion resistant aluminum extrusions. A replaceable Neoprene seal shall isolate the cover perimeter from the concrete and/or between every panel to ensure a significantly air-tight enclosure.

4.8 CONFIGURATION:

A. The Heavy-Duty Plank aluminum flat panel cover system shall be composed of beams and panels. Uplift of each panel shall be resisted with the use of quarter turn slam latch(s). Latch keys shall be provided by the panel Manufacturer. The weight of an individual panel shall not exceed 150 pounds. Each hinged panel can be easily removed or replaced via removing the bolt anchors of the "T-extrusion" to the beam underneath without disruption of adjacent panels.

PART 5 – MATERIALS

5.1 ALUMINUM

A. All extrusions comprising the Pleasant Mount Welding, Inc.'s Heavy-Duty Plank Aluminum Flat Panel Cover shall be alloy 6061-T6, of sufficient section modulus and moment of inertia to withstand the design loads. Material shall be of top quality.

5.2 WELDING ELECTRODES

A. Welding shall be done with electrodes of an alloy which shall produce welds with strength and corrosion resistance characteristics compatible to the base material.

5.3 FASTENERS

A. All fasteners between aluminum components shall be stainless steel. Beams and shelf angles shall be fastened to concrete using stainless steel drill in place anchor bolts.

5.4 STEEL ACCESSORIES

A. No carbon steel components shall be used.

5.5 GASKETS

A. Replaceable Neoprene gaskets shall be used to isolate the aluminum cover perimeter from the concrete and at all panel-to-panel interfaces.

PART 6 – WORKMANSHIP

6.1 The quality of the workmanship, fabrication, and shop connections shall be in accordance with the latest edition of ANSI/AWS D1.2 Structural Welding Code – Aluminum.

PART 7 – ENVIRONMENTAL CONSIDERATIONS

7.1 All aluminum used in the Heavy-Duty Flat Panel Cover system is presumed to be recyclable upon demolition.

PART 8 – OPERATION & MAINTENANCE MANUAL

8.1 The cover manufacturer shall provide an O&M Manual that includes maintenance instructions, removal and replacement instructions, and drawings for the install cover.

END OF SECTION 055902

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Framing with engineered wood products.
3. Shear wall panels.
4. Wood blocking, cants, and nailers.
5. Wood furring and grounds.
6. Plywood backing panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

1.3 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Engineered wood products.
4. Shear panels.
5. Power-driven fasteners.
6. Post-installed anchors.
7. Metal framing anchors.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.

2. For exposed lumber indicated to receive a stained or natural finish, omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3B for exterior construction not in contact with ground, and Use Category UC4A for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade.

1. Application: All interior partitions.
2. Species:
   a. Southern pine or mixed southern pine; SPIB.

b. Northern species; NLGA.
c. Eastern softwoods; NeLMA.

B. Framing Other Than Non-Load-Bearing Partitions: No. 2 grade.

1. Application: Framing other than interior partitions.
2. Species:
   a. Douglas fir-larch; WCLIB or WWPA.
   b. Southern pine or mixed southern pine; SPIB.

C. Framing Members 5 x 5 or larger: No. 1 grade.

1. Application: Girder Beams and Posts.
   Species:
   a. Douglas fir-larch; WCLIB or WWPA.
   b. Southern pine or mixed southern pine; SPIB.

D. Exposed Framing: Hand-select material for uniformity of appearance and freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot-holes, shake, splits, torn grain, and wane.

1. Species and Grade: As indicated above for load-bearing construction of same type.

2.4 ENGINEERED WOOD PRODUCTS

A. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D5456 and manufactured with an exterior-type adhesive complying with ASTM D2559.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Weyerhaeuser Company.
   b. Georgia-Pacific Gypsum LLC.
   c. Boise Cascade Corporation.

2. Extreme Fiber Stress in Bending, Edgewise: 2600 psi for 12-inch nominal-depth members.
3. Modulus of Elasticity, Edgewise: 2,000,000 psi.

2.5 SHEAR WALL PANELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Simpson Strong-Tie Co., Inc.
2. Weyerhaeuser Company.

B. Wood-Framed Shear Wall Panels: Prefabricated assembly consisting of wood perimeter framing, tie downs, and Exposure I, Structural I plywood or OSB sheathing.

C. Allowable design loads, as published by manufacturer, shall meet or exceed those of products of manufacturers listed. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.6 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.
6. Grounds.

B. Dimension Lumber Items: Standard, Stud, or No. 3 grade lumber of any species.

C. Concealed Boards: 19 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine or southern pine; No. 2 grade; SPIB.
2. Eastern softwoods; No. 2 Common grade; NeLMA.
3. Northern species; No. 2 Common grade; NLGA.

2.7 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.8 FASTENERS

A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

C. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193, or ICC-ES AC308 as appropriate for the substrate.

2.9 METAL FRAMING ANCHORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Simpson Strong-Tie Co., Inc.
2. USP Structural Connectors.

B. Allowable design loads, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.

C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.

1. Use for interior locations unless otherwise indicated.

D. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A653/A653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.

1. Use for wood-preservative-treated lumber and where indicated.

2.10 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated.

B. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.

C. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.

D. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

D. Install shear wall panels to comply with manufacturer's written instructions.

E. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

F. Do not splice structural members between supports unless otherwise indicated.

G. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

H. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

I. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
2. ICC-ES evaluation report for fastener.

3.2 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Roof sheathing.
3. Parapet sheathing.
4. Composite nail base insulated wall sheathing.
5. Structural concrete panel wall sheathing.
6. Subflooring.
7. Underlayment.
8. Sheathing joint and penetration treatment.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated plywood.
2. Fire-retardant-treated plywood.
3. Foam-plastic sheathing.

1.4 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested according to ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.3 FIRE-RETARDANT-TREATED PLYWOOD

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
3. Design Value Adjustment Factors: Treated lumber plywood shall be tested according to ASTM D5516 and design value adjustment factors shall be calculated according to ASTM D6305. Span ratings after treatment shall be not less than span ratings specified. For roof sheathing and where high-temperature fire-retardant treatment is indicated, span ratings for temperatures up to 170 deg F shall be not less than span ratings specified.

C. Kiln-dry material after treatment to a maximum moisture content of 15 percent.

D. Identify fire-retardant-treated plywood with appropriate classification marking of qualified testing agency.

2.4 WALL SHEATHING

A. Plywood Sheathing: DOC PS 1, Exposure 1, or Structural I sheathing.

B. Paper-Surfaced Gypsum Sheathing: ASTM C1396/C1396M, gypsum sheathing; with water-resistant-treated core and with water-repellent paper bonded to core's face, back, and long edges.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. American Gypsum.
    b. CertainTeed Gypsum.
    c. Georgia-Pacific Gypsum LLC.
    d. National Gypsum Company.
    e. USG Corporation.

2. Type and Thickness: Type X, 5/8 inch thick.

C. Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. CertainTeed Corporation.
    b. CertainTeed Gypsum.
    c. Continental Building Products, LLC.
    d. Georgia-Pacific Gypsum LLC.
    e. National Gypsum Company.
    f. USG Corporation.

2. Type and Thickness: Type X, 5/8 inch thick.

2.5 ROOF SHEATHING

A. Plywood Sheathing: DOC PS 1, sheathing.

2.6 PARAPET / DORMER SHEATHING

A. Plywood Sheathing: DOC PS 1, sheathing.

B. Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. CertainTeed Corporation.
    b. Georgia-Pacific Gypsum LLC.
    c. National Gypsum Company.
    d. USG Corporation.

2. Type and Thickness: Type X, 5/8 inch thick.

2.7 COMPOSITE NAIL-BASE INSULATED WALL SHEATHING

A. Plywood-Surfaced, Polyisocyanurate-Foam Sheathing: ASTM C1289, Type V with DOC PS 2, Exposure 1 plywood on one face.

1. Basis of Design : Composite wall panels shall be Xci Ply as manufactured by Hunter Panels with a total thickness of 2.6 inches, with a thermal value of R=12.7 as per ASTM C518 with a compressive strength of 20 psi min. as per ASTM 1621, moisture vapor permeance of less than 1 perm, water absorption of less than 1% by volume as per ASTM C209, resistance to mold to pass ASTM D3272 and a dimensional stability of 2% linear change as per ASTM D2126. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

2. Additional Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Atlas EPS; a Division of Atlas Roofing Corporation.
    b. Cornell Corporation.
    c. Dow Chemical Company (The).
    d. Johns Manville; a Berkshire Hathaway company.
    e. Rmax, Inc.

3. Polyisocyanurate-Foam Thickness: see description of Basis of Design.
4. Plywood Nominal Thickness: 5/8 inch.

2.8 STRUCTURAL CONCRETE PANEL WALL SHEATHING

1. 1/2” STRUCTO-CRETE® Brand Structural Panels as manufactured by USG or approved equal, a noncombustible structural wall panel manufactured in accordance with Acceptance Criteria AC318.

    A. Panel Dimensions:
        1. Thickness: 1/2"
        2. Width: 4'-0”
        3. Lengths: 8'-0”
        4. Square Edges

    B. Panel Properties:
        1. Density: 75 lb/ft^3 tested in accordance with ASTM C1185
        2. Weight: 3.5 lb/ft^2 tested in accordance with ASTM D1037 at a thickness of 1/2” (
        3. Noncombustibility: Pass tested in accordance with ASTM E136
        4. Surface Burning Characteristics: 0 Flame Spread / 0 Smoke Developed tested in accordance with ASTM E84
        5. Mold Resistance: 10 tested in accordance with ASTM D3273 0 tested in accordance with G21.

2.9 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For roof parapet and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

2. For structural concrete wall panel sheathing use Grabber CGH8158LG fastener type and spacing as recommended by the manufacturer for the intended use. Where the panel is designed as a shearwall, spacing shall conform to USG literature, engineering requirements, and code mandates.

2.10 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Glass-Mat Gypsum Sheathing: Elastomeric, medium-modulus, neutral-curing silicone joint sealant compatible with joint substrates formed by gypsum sheathing and other materials, recommended by sheathing manufacturer for application indicated and complying with requirements for elastomeric sealants specified in Section 079200 "Joint Sealants."

B. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

C. Sheathing Tape for Foam-Plastic Sheathing: Pressure-sensitive plastic tape recommended by sheathing manufacturer for sealing joints and penetrations in sheathing.

2.11 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with APA AFG-01 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
2. ICC-ES evaluation report for fastener.

D. Coordinate roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Combination Subfloor-Underlayment:

a. Glue and nail to wood framing.
b. Screw to cold-formed metal framing.
c. Space panels 1/8 inch apart at edges and ends.

2. Subflooring:

a. Glue and nail to wood framing.
b. Screw to cold-formed metal framing.
c. Space panels 1/8 inch apart at edges and ends.

3. Wall and Roof Sheathing:

a. Nail to wood framing. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.
b. Screw to cold-formed metal framing.
c. Space panels 1/8 inch apart at edges and ends.

3.3 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to wood framing with screws.
2. Fasten gypsum sheathing to cold-formed metal framing with screws.
3. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.

4. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Seal sheathing joints according to sheathing manufacturer's written instructions.
   1. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION 061600

SECTION 062023 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior trim, including non-fire-rated interior door and sidelight frames.
2. Shelving and clothes rods.

1.2 DEFINITIONS

A. MDF: Medium-density fiberboard.

B. PVC: Polyvinyl chloride.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

B. Samples: For each exposed product and for each color and texture specified.

1.4 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by grading agency.

B. Softwood Plywood: DOC PS 1.

C. Hardboard: ANSI A135.4.

D. MDF: ANSI A208.2, Grade 130.

E. Particleboard: ANSI A208.1, Grade M-2.

2.2 INTERIOR TRIM

A. Softwood Lumber Trim for Transparent Finish (Stain or Clear Finish):

1. Species and Grade: Eastern white pine; NeLMA or NLGA Finish or 1 Common. Or equivalent species and grade
2. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
3. Finger Jointing: Allowed only at wood receiving opaque finish.
4. Face Surface: Surfaced (smooth).

B. Hardwood Lumber Trim for Transparent Finish (Stain or Clear Finish):

1. Species and Grade: Red oak or yellow poplar; NHLA Clear.
2. Maximum Moisture Content: 10 percent.
3. Finger Jointing: Not allowed.
4. Gluing for Width: Use for lumber trim wider than 6 inches.
5. Veneered Material: Not allowed.
6. Face Surface: Surfaced (smooth).
7. Matching: Selected for compatible grain and color.

C. Lumber Trim for Opaque Finish (Painted Finish):

1. Species and Grade: Eastern white pine; NeLMA or NLGA Finish or 1 Common. Or equivalent species and grade.
2. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
3. Maximum Moisture Content: 10 percent.
4. Finger Jointing: Allowed.
5. Face Surface: Surfaced (smooth).
6. Optional Material: Primed MDF of same actual dimensions as lumber indicated may be used in lieu of lumber.

D. Softwood Moldings for Transparent Finish (Stain or Clear Finish): MMPA WM 4, N-grade wood moldings. Made to patterns included in MMPA's "WM/Series Softwood Moulding Patterns."

1. Species: Eastern White. Pine; NeLMA or NLGA Finish or 1 common.
2. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
3. Finger Jointing: Not allowed.
4. Matching: Selected for compatible grain and color.
5. Base Pattern: WM 623, 9/16-by-3-1/4-inch ogee base.
6. Shoe-Mold Pattern: WM 129, 7/16-by-11/16-inch quarter-round shoe mold.
7. Casing Pattern: WM 324, 11/16-by-2-1/4-inch casing.
8. Mull-Casing Pattern: WM 973, 3/8-by-1-3/4-inch bullnose casing.
9. Stop Pattern: WM 886, 3/8-by-1-3/8-inch bullnose stop.
10. Chair-Rail Pattern: WM 297, 11/16-by-3-inch chair rail.

E. Hardwood Moldings for Transparent Finish (Stain or Clear Finish): MMPA WM 4, N-grade wood moldings made to patterns included in MMPA's "HWM/Series Hardwood Moulding Patterns."

1. Species: Red oak or yellow poplar.
2. Maximum Moisture Content: 9 percent.
3. Finger Jointing: Not allowed.
4. Matching: Selected for compatible grain and color.
5. Optional Material: Kiln-dried softwood or MDF, with exposed surfaces veneered with species indicated, may be used in lieu of solid wood.
6. Base Pattern: HWM 633, 7/16-by-3-1/4-inch ogee base.
7. Shoe-Mold Pattern: HWM 129, 7/16-by-11/16-inch quarter-round shoe mold.
8. Casing Pattern: WM 324, 1/2-by-2-1/4-inch casing.
9. Mull-Casing Pattern: HWM 989, 3/16-by-2-inch square-edge casing.
10. Stop Pattern: HWM 886, 3/8-by-1-3/8-inch bullnose stop.
11. Chair-Rail Pattern: HWM 297, 11/16-by-3-inch chair rail.

F. Moldings for Opaque Finish (Painted Finish): Made to patterns included in MMPA's "WM/Series Softwood Moulding Patterns."

1. Softwood Moldings: MMPA WM 4, P grade.

    a. Species: Eastern white.
    b. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.

2. Hardwood Moldings: MMPA WM 4, P-grade.

    a. Species: Yellow poplar.
    b. Maximum Moisture Content: 9 percent.

3. Finger Jointing: Allowed.
4. Optional Material: Primed MDF.
5. Base Pattern: WM 623, 9/16-by-3-1/4-inch ogee base.
6. Shoe-Mold Pattern: WM 129, 7/16-by-11/16-inch quarter-round shoe mold.
7. Casing Pattern: WM 324, 11/16-by-2-1/4-inch casing.
8. Mull-Casing Pattern: WM 973, 3/8-by-1-3/4-inch bullnose casing.
9. Stop Pattern: WM 886, 3/8-by-1-3/8-inch bullnose stop.
10. Chair-Rail Pattern: WM 297, 11/16-by-3-inch chair rail.

2.3 PANELING

A. Hardwood Veneer Plywood Paneling: Manufacturer's stock hardwood plywood panels complying with HPVA HP-1.

1. Face Veneer Species and Cut: Rotary-cut white birch Plain-sliced red oak.
2. Veneer Matching: Selected for similar color and grain.
3. Backing Veneer Species: Same species as face veneer.
4. Construction: Veneer core.
5. Thickness: 1/4 inch.

6. Panel Size: 48 by 96 inches.
7. Glue Bond: Type II (interior).
8. Face Pattern: Manufacturer's standard channel-grooved pattern, with grooves at edges, center, and third points of panels, and at other locations to provide pattern resembling random-width boards.
9. Finish: As selected by Engineer/Architect from manufacturer's full range.

B. Hardboard Paneling: Interior factory-finished hardboard paneling complying with ANSI A135.5.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Georgia-Pacific Gypsum LLC.
   b. Marlite.

2. Thickness: 1/4 inch.
3. Finish: Class I.
4. Surface-Burning Characteristics: As follows, tested according to ASTM E84:

   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 450 or less.

5. Colors, Textures, and Patterns: As selected by Engineer/Architect from manufacturer's full range.

C. Board Paneling: Interior wood-board paneling complying with MMPA WM 9.

1. Species: Eastern white pine.
2. Grade: Clear No. 2.
3. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
4. Pattern: V-joint, tongue and groove, PT 82.
5. Net Coverage Width: Not less than 6-3/4 inches.

D. Board Paneling:

1. Species and Grade: Eastern white pine; NeLMA or NLGA Finish or 1 Common.
2. Species and Grade: Idaho white, lodgepole, ponderosa, radiata, or sugar pine; NLGA or WWPA 1 Common (Colonial).
3. Species and Grade: Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine; NeLMA, NLGA, or WWPA Finish or 1 Common (Colonial).
4. Species and Grade: Southern pine; SPIB B & B Paneling.
5. Species and Grade: Western red cedar; NLGA, WCLIB, or WWPA Clear Heart.
6. Maximum Moisture Content: 15 percent with at least 85 percent of shipment at 12 percent or less.
7. Pattern: V-joint, tongue and groove, NeLMA EWP 4 SPIB SPP 54 or WWPA WP 4.
8. Sizes in "Net Coverage Width" Subparagraph below represent 6-, 8-, and 10-inch (150-, 200-, 254-mm) nominal widths.
9. Net Coverage Width: Not less than 6-3/4 inches.

2.4 SHELVING AND CLOTHES RODS

A. Closet Shelving: Made from one of the following materials, 3/4 inch thick:
   1. MDF with solid-wood front edge.

B. Adjustable Shelf Brackets: BHMA A156.9, B04112; powder-coat-finished steel.

C. Clothes Rods: 1-5/16-inch-diameter, aluminum tubes.

D. Rod Flanges: Aluminum.

2.5 MISCELLANEOUS MATERIALS

A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.

B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.

C. Multipurpose Construction Adhesive: Formulation, complying with ASTM D3498, that is recommended for indicated use by adhesive manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

3.2 INSTALLATION, GENERAL

A. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials.

   1. Use concealed shims where necessary for alignment.
   2. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
   3. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
   4. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining interior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
   5. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

3.3 STANDING AND RUNNING TRIM INSTALLATION

A. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available.

1. Do not use pieces less than 24 inches long, except where necessary.
2. Stagger joints in adjacent and related standing and running trim.
3. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint.
4. Use scarf joints for end-to-end joints.
5. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.
6. Match color and grain pattern of trim for transparent finish (stain or clear finish) across joints.
7. Install trim after gypsum-board joint finishing operations are completed.
8. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting.
9. Fasten to prevent movement or warping.
10. Countersink fastener heads on exposed carpentry work and fill holes.

3.4 SHELVING AND CLOTHES ROD INSTALLATION

A. Cut shelf cleats at ends of shelves about 1/2 inch less than width of shelves and sand exposed ends smooth.

1. Install shelf cleats by fastening to framing or backing with finish nails or trim screws, set below face and filled.
2. Space fasteners not more than 16 inches o.c. Use two fasteners at each framing member or fastener location for cleats 4 inches nominal in width and wider.
3. Apply a bead of multipurpose construction adhesive to back of shelf cleats before installing.
4. Remove adhesive that is squeezed out after fastening shelf cleats in place.

B. Install shelf brackets according to manufacturer's written instructions, spaced not more than 32 inches o.c. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.

C. Install standards for adjustable shelf supports according to manufacturer's written instructions. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors. Space fasteners not more than 12 inches o.c.

D. Install standards for adjustable shelf brackets according to manufacturer's written instructions, spaced not more than 36 inches o.c. and within 6 inches of ends of shelves. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.

E. Cut shelves to neatly fit openings with only enough gap to allow shelves to be removed and reinstalled.

1. Install shelves, fully seated on cleats, brackets, and supports.
2. Fasten shelves to cleats with finish nails or trim screws, set flush.

3. Fasten shelves to brackets to comply with bracket manufacturer's written instructions.

F. Install rod flanges for rods as indicated.

1. Fasten to shelf cleats, framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors.
2. Install rods in rod flanges.

END OF SECTION 062023

SECTION 064113 - WOOD-VENEER-FACED ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood-veneer-faced architectural cabinets.
2. Wood furring, blocking, shims, and hanging strips for installing architectural cabinets that are not concealed within other construction.
3. Shop finishing of architectural cabinets.

B. Related Requirements:

1. Section 123640 "Stone Countertops" for countertops, back-splashes and side-splashes to coordinate with work specified in this section.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Location to be determined.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings: For architectural cabinets.

1. Include plans, elevations, sections, and attachment details.
2. Product catalogue information including finish and color selection options.

C. Samples: For each exposed product and for each color and finish specified.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Research reports.

C. Field quality control reports.

1.5 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: KCMA and ANSI A161.1 standards.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1. Manufacturer's product quality is fabricated to meet the KCMA and ANSI A161.1 standards.

PART 2 - PRODUCTS

2.1 ARCHITECTURAL CABINET MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. KraftMaid
2. Medallion
3. Diamond
4. Omega

2.2 CABINETS, GENERAL

A. Quality Standard: Unless otherwise indicated, meet or exceed the ANSI A161.1 performance and construction standards and finishes and other requirements for kitchen and vanity cabinets as certified by ICC-ES (International Code Council – Evaluation Service).

2.3 WOOD CABINETS FOR TRANSPARENT FINISH

A. Architectural Woodwork Standards Grade: Premium Custom.

B. Type of Construction: Face frame.

C. Door and Drawer-Front Style: Reveal overlay.

1. Reveal Dimension: 1/2 inch.

D. Wood for Exposed Surfaces: As indicated on Drawings.

1. Species: Red oak
2. Cut: Plain sliced/plain sawn.
3. Grain Direction: Vertically for doors and fixed panels, horizontally for drawer fronts.
4. Matching of Veneer Leaves: Book match.

5. Veneer Matching within Panel Face: Balance match.

E. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners.

2.4 WOOD CABINETS FOR OPAQUE FINISH

A. Architectural Woodwork Standards Grade: Custom.

B. Type of Construction: Face frame.

C. Door and Drawer-Front Style: As selected by owner to have reveal overlay with reveal dimension to be 1/2 inch.

D. Species for Exposed Lumber Surfaces: Any closed-grain hardwood.

E. Panel Product for Exposed Surfaces: Medium-density overlay.

F. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners.

2.5 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3 inches wide.
2. Wood Moisture Content: 8 to 13 percent.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

2.6 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials that are acceptable to authorities having jurisdiction as determined by testing performed on identical products by a qualified testing agency.

1. Use treated materials that comply with requirements of referenced quality standard. Do not use materials that are warped, discolored, or otherwise defective.

2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

2.7 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087100 "Door Hardware."

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Häfele America Co.
b. Blum, Julius & Co., Inc.

B. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 100 degrees of opening, with soft-closing mechanism feature.

C. Back-Mounted Pulls: ANSI/BHMA A156.9, B02011.

D. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.

E. Catches: Magnetic catches, ANSI/BHMA A156.9, B03141.

F. Adjustable Shelf Standards and Supports: ANSI/BHMA A156.9, B04071; with shelf rests, B04081.

G. Shelf Rests: ANSI/BHMA A156.9, B04013; metal.

H. Drawer Slides: ANSI/BHMA A156.9.

1. Heavy-Duty (Grade 1HD-100 and Grade 1HD-200): Undermounted; full-extension type; zinc-plated-steel, ball-bearing slides with soft-closing mechanism.
2. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 1.
3. For drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide Grade 1HD-100.
4. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-100.
5. For computer keyboard shelves, provide Grade 1HD-100.
6. For trash bins not more than 20 inches high and 16 inches wide, provide Grade 1HD-100.

I. Door Locks: ANSI/BHMA A156.11, E07121.

J. Drawer Locks: ANSI/BHMA A156.11, E07041.

K. Door and Drawer Silencers: ANSI/ BHMA A156.16, L03011.

L. Grommets for Cable Passage: 1-1/4-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.

1. Color: To be selected by Architect from Manufacturer’s full range of colors.

M. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for BHMA finish number indicated.

1. Dark, Oxidized, Satin Bronze, Oil Rubbed: ANSI/BHMA 613 for bronze base; ANSI/BHMA 640 for steel base; match Architect's sample.
2. Bright Brass, Clear Coated: ANSI/BHMA 605 for brass base; ANSI/BHMA 632 for steel base.
3. Bright Brass, Vacuum Coated: ANSI/BHMA 723 for brass base; ANSI/BHMA 729 for zinc-coated-steel base.
4. Satin Brass, Blackened, Bright Relieved, Clear Coated: ANSI/BHMA 610 for brass base; ANSI/BHMA 636 for steel base.
5. Satin Chromium Plated: ANSI/BHMA 626 for brass or bronze base; ANSI/BHMA 652 for steel base.
6. Bright Chromium Plated: ANSI/BHMA 625 for brass or bronze base; ANSI/BHMA 651 for steel base.
7. Satin Stainless Steel: ANSI/BHMA 630.

N. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.8 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

2.9 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

2.10 SHOP FINISHING

A. General: Finish architectural cabinets at manufacturer's shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. General: Shop finish transparent-finished architectural cabinets at manufacturer's shop as specified in this Section. See Section 099123 "Interior Painting" for field finishing of opaque-finished architectural cabinets.

C. General: Drawings indicate items that are required to be shop finished. Finish these items at manufacturer's shop as specified in this Section. See Section 099123 "Interior Painting" for field finishing of architectural cabinets.

D. Shop Priming: Shop apply the prime coat including backpriming, if any, for transparent-finished items specified to be field finished. See Section 099123 "Interior Painting" for material and application requirements.

E. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural cabinets, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of cabinets.

F. Transparent Finish:

1. Architectural Woodwork Standards Grade: Custom.
2. Finish: System - 8, water-based crosslinking acrylic.
3. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to cabinets made from closed-grain wood before staining and finishing.
4. Staining: Color to be selected by Architect.
5. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
6. Filled Finish for Open-Grain Woods: After staining, apply wash-coat sealer and allow to dry. Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
7. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D523.

G. Opaque Finish:

1. Architectural Woodwork Standards Grade: Custom.
2. Finish: System - 8, water-based crosslinking acrylic.
3. Color: Color to be selected by Architect.
4. Sheen: Satin, 31-45 gloss units measured on 60-degree gloss meter per ASTM D523.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

B. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.

C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with cabinet surface.

1. For shop-finished items, use a filler matching finish of items being installed.

D. Install cabinets level, plumb, and true in line with a tolerance of 1/8 inch in 96 inches using concealed shims.

1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
3. Maintain veneer sequence matching of cabinets with transparent finish.
4. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips.

E. Shop Finishes: Touch up finishing after installation of architectural cabinets. Fill nail holes with matching filler.

F. Field Finishing: See Section 099123 "Interior Painting" for finishing of installed architectural cabinets.

3.2 CLEANING

A. Clean and touch up minor finish damage. Remove and replace components that cannot be successfully cleaned and repaired.

END OF SECTION 064113

SECTION 066400 - PLASTIC PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes plastic sheet paneling.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For plastic paneling and trim accessories.

1.3 QUALITY ASSURANCE

A. Testing Agency: Acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 PVC WALL AND CEILING PANELING

A. Extruded Plastic Paneling: 100% virgin exterior grade PVC plastic panels complying with ASTM D5319. Panels shall be USDA accepted for incidental food contact.

1. Basis of Design: P1300 wall and ceiling panels and associated trim and accessories as manufactured by Extrutech Plastics, Inc. (888) 818-0118, www.epiplastics.com

2. Additional Manufacturers: Subject to compliance with requirements, other available manufacturers making similar products may be incorporated into the Work.

3. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E84. Identify products with appropriate markings from an applicable testing agency.

   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 450 or less.

4. Nominal Thickness: Not less than 0.50 inch.

5. Weight: 0.06 pounds per linear foot
6. Surface Finish: Smooth.
7. Color: As selected by Architect from manufacturer's full range.

2.2 FRP WALL PANELS

A. FRP Wall Panels: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D5319.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Marlite, Inc.
   b. Crane Composites, Inc.
   c. Kal-Lite, a division of Kalwall Corporation

2. Surface-Burning Characteristics: As follows when tested by a qualified testing agency in accordance with ASTM E84. Identify products with appropriate markings from an applicable testing agency.

   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 450 or less.

3. Nominal Thickness: Not less than 0.09 inch.
4. Surface Finish: Smooth.
5. Color: As selected by Architect from manufacturer's full range.

2.3 ACCESSORIES

B. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.

1. Color: Match panels.

C. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.

B. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

C. Lay out paneling before installing. Locate panel joints. To provide proper fastening to substrate as necessary for secure installation to anchor components firmly in place for ling life under hard use.

3.2 INSTALLATION

A. Install plastic paneling according to manufacturer's written instructions.

B. Install panels in a full spread of adhesive.

C. Install trim accessories with nails or screws. Do not fasten through panels, fasten through tabs.

D. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.

E. Maintain uniform space between panels and wall fixtures. Fill space with sealant.

F. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION 066400

SECTION 071616 - CRYSTALLINE WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Crystalline waterproofing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: A firm experienced in applying crystalline waterproofing similar in material, design, and extent to that indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

1.5 FIELD CONDITIONS

A. Proceed with waterproofing work only after pipe sleeves, vents, curbs, inserts, drains, and other projections through the substrate to be waterproofed have been completed. Proceed only after substrate defects, including honeycombs, voids, and cracks, have been repaired to provide a sound substrate free of forming materials, including reveal inserts.

B. Ambient Conditions: Proceed with waterproofing work only if temperature is maintained at 40 deg F or above during work and cure period, and space is well ventilated and kept free of water.

PART 2 - PRODUCTS

2.1 WATERPROOFING MATERIALS

A. Crystalline Waterproofing: Prepackaged, gray-colored proprietary blend of portland cement, specially treated sand, and active chemicals that, when mixed with water and applied, penetrates into concrete and concrete unit masonry and reacts chemically with the byproducts of cement

hydration in the presence of water to develop crystalline growth within substrate capillaries to produce an impervious, dense, waterproof substrate; with properties complying with or exceeding the criteria specified below.

1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Xypex Chemical Corporation.
2. Water Permeability: Maximum zero for water at 30 feet when tested according to COE CRD-C 48.
3. Compressive Strength: Minimum 4000 psi at 28 days when tested according to ASTM C109/C109M.

2.2 ACCESSORY MATERIALS

A. Patching Compound: Factory-premixed cementitious repair mortar, crack filler, or sealant recommended by waterproofing manufacturer for filling and patching tie holes, honeycombs, reveals, and other imperfections; and compatible with substrate and other materials indicated.

B. Plugging Compound: Factory-premixed cementitious compound with hydrophobic properties and recommended by waterproofing manufacturer; resistant to water and moisture but vapor permeable for all standard applications (vertical, overhead, and horizontal surfaces not exposed to vehicular traffic); and compatible with substrate and other materials indicated.

C. Water: Potable.

2.3 MIXES

A. Crystalline Waterproofing: Add prepackaged dry ingredients to water according to manufacturer's written instructions. Mix together with mechanical mixer or by hand to required consistency.

PART 3 - EXECUTION

3.1 PREPARATION

A. Comply with manufacturer's written instructions.

B. Protect other work from damage caused by cleaning, preparation, and application of waterproofing. Provide temporary enclosure to confine spraying operation and to ensure adequate ambient temperatures and ventilation conditions for application.

C. Do not allow waterproofing, patching, and plugging materials to enter reveals or annular spaces intended for resilient sealants or gaskets, such as joint spaces between pipes and pipe sleeves.

D. Stop active water leaks with plugging compound.

E. Repair damaged or unsatisfactory substrate with patching compound.

1. At holes and cracks 1/16 inch wide or larger in substrate, remove loosened chips and cut reveal with sides perpendicular to surface, not tapered, and minimum 1 inch deep. Fill reveal with patching compound flush with surface.

F. Surface Preparation: Remove efflorescence, chalk, dust, dirt, mortar spatter, grease, oils, paint, curing compounds, and form-release agents to ensure that waterproofing bonds to surfaces.

3.2 INSTALLATION

A. Comply with waterproofing manufacturer's written instructions for application and curing.

1. Saturate surface with water for several hours and maintain damp condition until applying waterproofing. Remove standing water.
2. Apply waterproofing to surfaces, and extend waterproofing onto adjacent surfaces as follows:

    a. Onto columns integral with treated walls.
    b. Onto interior nontreated walls intersecting exterior treated walls, for a distance of 24 inches for cast-in-place concrete and 48 inches for masonry.
    c. Onto exterior walls and onto both exterior and interior columns, for a height of 12 inches, where floors, but not walls, are treated.
    d. Onto every substrate in areas indicated for treatment, including but not limited to: pipe trenches pipe chases pits sumps and similar offsets and features.

3. Number of Coats: Number required for specified water permeability.
4. Application Method: Apply to ensure that each coat fills voids and is in full contact with substrate or previous coat.
5. Dampen surface between coats.

B. Final Coat Finish: Smooth.

C. Curing: Moist-cure waterproofing for three days immediately after final coat has set, followed by air drying, unless otherwise recommended in writing by manufacturer.

END OF SECTION 071616

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board insulation.
2. Polyisocyanurate foam-plastic board insulation.
3. Glass-fiber blanket insulation.
4. Mineral-wool blanket insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Extruded polystyrene foam-plastic board insulation.
2. Polyisocyanurate foam-plastic board insulation.
3. Glass-fiber blanket insulation.
4. Mineral-wool blanket insulation.

1.3 INFORMATIONAL SUBMITTALS

A. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.

1. Sign, date, and post the certification in a conspicuous location on Project site.

B. Product test reports.

C. Research reports.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION

A. Extruded Polystyrene Board Insulation, Type X: ASTM C578, Type X, 15-psi minimum compressive strength; unfaced.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Dow Chemical Company (The).

b. Owens Corning.

2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
3. Smoke-Developed Index: Not more than 450 when tested in accordance with ASTM E84.
4. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
5. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

B. Extruded Polystyrene Board Insulation, Type V: ASTM C578, Type V, 100-psi minimum compressive strength.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Dow Chemical Company (The).
b. Owens Corning.

2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
3. Smoke-Developed Index: Not more than 450 when tested in accordance with ASTM E84.
4. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

2.2 POLYISOCYANURATE FOAM-PLASTIC BOARD INSULATION

A. Polyisocyanurate Board Insulation, Foil Faced: ASTM C1289, foil faced, Type I, Class 1 or 2.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Carlisle Coatings & Waterproofing Inc.
b. Dow Chemical Company (The).
c. Hunter Panels.

2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
3. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

2.3 GLASS-FIBER BLANKET INSULATION

A. Glass-Fiber Blanket Insulation, Kraft Faced: ASTM C665, Type II (nonreflective faced), Class C (faced surface not rated for flame propagation); Category 1 (membrane is a vapor barrier).

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Owens Corning.

2. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

2.4 MINERAL-WOOL BLANKET INSULATION – FOR INTERIOR SOUND CONTROL

A. Mineral-Wool Blanket Insulation, Unfaced: ASTM C665, Type I (blankets without membrane facing); consisting of fibers; passing ASTM E136 for combustion characteristics.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Johns Manville; a Berkshire Hathaway company.
b. Rockwool International.
c. Thermafiber, Inc.; an Owens Corning company.

2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
3. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.
4. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

2.5 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.
2. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.

B. Insulation Anchors, Spindles, and Standoffs: As recommended by manufacturer.

C. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

D. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide ventilation between insulated attic spaces and vented eaves.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Install insulation with manufacturer's R-value label exposed after insulation is installed.

D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.2 INSTALLATION OF SLAB INSULATION

A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

1. If not otherwise indicated, extend insulation a minimum of 36 inches below exterior grade line.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

1. If not otherwise indicated, extend insulation in 36 inches minimum from exterior walls.

3.3 INSTALLATION OF FOUNDATION WALL INSULATION

A. Butt panels together for tight fit.

B. Anchor Installation: Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors.

C. Adhesive Installation: Install with adhesive or press into tacky waterproofing or damp-proofing according to manufacturer's written instructions.

3.4 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face and as recommended by manufacturer.

1. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.
2. Press units firmly against inside substrates.
3. Supplement adhesive attachment of insulation by securing boards with screws and polypropylene washer system designed for this purpose.

3.5 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. Attics: Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
5. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
6. For wood-framed construction, install blankets to meet ASTM C1320 and as follows:

    a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.

7. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings and seal each continuous area of insulation to ensure airtight installation.

    a. Exterior Walls: Set units with facing placed toward air space.
    b. Interior Walls: Set units with facing placed toward areas of high humidity if applicable.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.
2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.6 INSTALLATION OF CURTAIN-WALL INSULATION

A. Install board insulation in curtain-wall construction according to curtain-wall manufacturer's written instructions.

1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of dimension indicated on Drawings between insulation and glass.
2. Install insulation to fit snugly without bowing.

END OF SECTION 072100

SECTION 072119 - FOAMED-IN-PLACE INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Open-cell spray polyurethane foam.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Research reports.

PART 2 - PRODUCTS

2.1 OPEN-CELL SPRAY POLYURETHANE FOAM

A. Open-Cell Spray Polyurethane Foam: Spray-applied polyurethane foam using water as a blowing agent. Minimum density of 0.5 lb/cu. ft. and minimum aged R-value at 1-inch thickness of 3.4 deg F x h x sq. ft./Btu at 75 deg F.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. BASF Corporation.
b. Demilec (USA) LLC.
c. Icynene-Lapolla; Icynene.
d. Johns Manville; a Berkshire Hathaway company.

2. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings from an applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 450 or less.

3. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Spray insulation to envelop the entire area to be insulated and fill voids.

C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.

END OF SECTION 072119

SECTION 072500 - WEATHER BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Building wrap.
   2. Flexible flashing.
   3. Drainage material.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For water-resistive barrier and flexible flashing, from ICC-ES.

PART 2 - PRODUCTS

2.1 WATER-RESISTIVE BARRIER

A. Building Wrap: ASTM E1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E84; UV stabilized; and acceptable to authorities having jurisdiction.

   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

      a. Dow Chemical Company (The).
      b. DuPont Safety and Construction.
      c. TYPAR.
   2. Water-Vapor Permeance: Not less than 8 perms per ASTM E96/E96M, Desiccant Method (Procedure A).
   3. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.

B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.2 FLEXIBLE FLASHING

A. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. DuPont Safety and Construction.
    b. TYPAR.
2. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.

B. Rubberized-Asphalt Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Carlisle Coatings & Waterproofing Inc.
    b. TYPAR.
2. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.

2.3 DRAINAGE MATERIAL

A. Drainage Material: Product shall maintain a continuous open space between water-resistive barrier and exterior cladding to create a drainage plane and shall be used under siding.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. DuPont Safety and Construction.
    b. Insulfoam; Carlisle Construction Materials Company.
    c. TYPAR.
2. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.

PART 3 - EXECUTION

3.1 WATER-RESISTIVE BARRIER INSTALLATION

A. Cover sheathing with water-resistive barrier as follows:

1. Cut back barrier 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations.
2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap unless otherwise indicated.

B. Building Wrap: Comply with manufacturer's written instructions and warranty requirements.

1. Seal seams, edges, fasteners, and penetrations with tape.
2. Extend into jambs of openings and seal corners with tape.

3.2 FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.

1. Lap seams and junctures with other materials at least 4 inches except that at flashing flanges of other construction, laps need not exceed flange width.
2. Lap flashing over water-resistive barrier at bottom and sides of openings.
3. Lap water-resistive barrier over flashing at heads of openings.

3.3 DRAINAGE MATERIAL INSTALLATION

A. Install drainage material over building wrap and flashing to comply with manufacturer's written instructions.

END OF SECTION 072500

SECTION 074113.16 - STANDING-SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Standing-seam metal roof panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at a location to be determined.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

C. Samples: For each type of metal panel indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Warranties: Sample of special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Finish Warranty Period: 20 years from date of Substantial Completion.

C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Energy Performance: Provide roof panels that are listed on the EPA/DOE's ENERGY STAR "Roof Product List" for conventional-slope roof products.

B. Energy Performance: Provide roof panels according to one of the following when tested according to CRRC-1:

1. Three-year, aged solar reflectance of not less than 0.55 and emissivity of not less than 0.75.
2. Three-year, aged Solar Reflectance Index of not less than 64 when calculated according to ASTM E1980.

C. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/240 of the span.

D. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E1680 or ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft.

E. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E1646 or ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft.

F. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E2140.

G. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 90.

H. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.

1. Fire/Windstorm Classification: Class 1A- 90.
2. Hail Resistance: MH.

I. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 STANDING-SEAM METAL ROOF PANELS

A. Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.

1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1514.
2. Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1637.

B. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and mechanically seaming panels together.

1. Basis of Design: S2500 metal roof system as manufactured by Englert, Inc. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Berridge Manufacturing Co.

b. McElroy Metal, Inc.

c. MBCI Metal Roof and Wall Systems, Inc.

2. Aluminum Sheet: Coil-coated sheet, ASTM B209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

   a. Structural Support: Over open framing.
   b. Materials: Metallic coated steel
   c. Panel Profile: Intermediate stiffening ribs symmetrically spaced between seams.
   d. Panel Coverage: 16 inches.
   e. Panel Height: 2 inches.
   f. Thickness: 22 gauge.
   g. Exterior Finish: Two-coat fluoropolymer.
   h. Color: As selected by Engineer/Architect from manufacturer's full range.

3. Clips: One-piece fixed to accommodate thermal movement.

   a. Material: 0.028-inch- nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.

   b. Clip Spacing: 36 inches or at purlin spacings. To be coordinated.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: Stable after testing at 240 deg F; ASTM D1970.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D1970.

3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Carlisle WIP Products; a brand of Carlisle Construction Materials.
   b. Henry Company.
   c. Owens Corning.

B. Felt Underlayment: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felts.

C. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.4 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Sub-framing and Furring: ASTM C645; cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50 coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets,

fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or pre-molded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Gutters and Downspouts: Formed from same material as roof panels according to SMACNA's "Architectural Sheet Metal Manual." Finish to match roof fascia and rake trim.

E. Roof Curbs: Fabricated from same material as roof panels, 0.048-inch nominal thickness; with bottom of skirt profiled to match roof panel profiles and with welded top box and integral full-length cricket. Fabricate curb sub-framing of 0.060-inch-nominal thickness, angle-, C-, or Z-shaped steel sheet. Fabricate curb and sub-framing to withstand indicated loads of size and height indicated. Finish roof curbs to match metal roof panels.

F. Panel Fasteners: Self-tapping screws designed to withstand design loads.

G. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C920; as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.5 FABRICATION

A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.6 FINISHES

A. Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat.
2. Concealed Finish: White or light-colored acrylic or polyester backer finish.

PART 3 - EXECUTION

3.1 PREPARATION

A. Miscellaneous Supports: Install sub-framing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.2 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated on Drawings, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
1. Apply over the roof area indicated below:

a. Roof perimeter for a distance up from eaves of 36 inches beyond interior wall line.
b. Valleys, from lowest point to highest point, for a distance on each side of 18 inches. Overlap ends of sheets not less than 6 inches.
c. Rake edges for a distance of 18 inches.
d. Hips and ridges for a distance on each side of 12 inches.
e. Roof-to-wall intersections for a distance from wall of 18 inches.
f. Around dormers, chimneys, skylights, and other penetrating elements for a distance from element of 18 inches.

B. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.

C. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

3.3 INSTALLATION OF STANDING SEAM METAL ROOF PANELS

A. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
4. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
5. Watertight Installation:

    a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
    b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
    c. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

B. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

C. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

3.4 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074113.16

SECTION 074213.13 - FORMED METAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concealed-fastener, lap-seam metal wall panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project Site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

C. Samples: For each type of metal panel indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Warranties: Samples of special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Finish Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/180 of the span.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft.

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

E. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings from an applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS

A. Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories required for weathertight installation.

B. Flush-Profile, Concealed-Fastener Metal Wall Panels: Formed with horizontal panel edges and a flat pan between panel edges; with flush joint between panels.

1. Basis of Design: ATAS International, Inc. Opaline 8” wide panels (OPF Profile)

2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Berridge Manufacturing Company.
   b. PAC-CLAD; Petersen Aluminum Corporation; a Carlisle company.

3. Aluminum Sheet: Coil-coated sheet, ASTM B209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

   a. Thickness: .024 inch.
   b. Surface: Smooth, flat finish.
   c. Exterior Finish: Two-coat fluoropolymer.
   d. Color: As selected by Engineer/Architect from manufacturer's full range.

4. Panel Coverage: 12 inches.
5. Panel Height: 1 inch.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Sub-framing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or pre-molded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C920; as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.4 FABRICATION

A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.5 FINISHES

A. Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat.
2. Siliconized Polyester: Epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.2 mil for primer and 0.8 mil for topcoat.

3. Concealed Finish: White or light-colored acrylic or polyester backer finish.

PART 3 - EXECUTION

3.1 PREPARATION

A. Miscellaneous Supports: Install sub-framing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.2 INSTALLATION

A. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
5. Flash and seal panels with weather closures at perimeter of all openings.

B. Watertight Installation:

1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels; and elsewhere as needed to make panels watertight.
2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

C. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

D. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

3.3 CLEANING

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074213.13

SECTION 074293 - SOFFIT PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes metal soffit panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

C. Samples: For each type of metal panel indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Warranties: Samples of special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/240 of the span.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft.

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient.

2.2 METAL SOFFIT PANELS

A. General: Provide metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.

B. Metal Soffit Panels: Match profile and material of metal roof panels.

1. Finish: Color to be as selected by Engineer/Architect from manufacturer's full range of colors.
2. Sealant: Factory applied within interlocking joint.

C. V-Groove-Profile Metal Soffit Panels: Perforated panels formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced between panel edges; with a V-groove joint between panels.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. ATAS International, Inc.
b. Berridge Manufacturing Company.
c. Dimensional Metals, Inc.
d. Englert, Inc.
e. Fabral.
f. Innovative Metals Company, Inc.
g. McElroy Metal, Inc.
h. PAC-CLAD; Petersen Aluminum Corporation; a Carlisle company.

2. Material: Same material, finish, and color as metal roof panels.

3. Aluminum Sheet: Coil-coated sheet, ASTM B209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

a. Thickness: 0.032 inch.
b. Surface: Smooth, flat finish.
c. Exterior Finish: Two-coat fluoropolymer.
d. Color: As selected by Engineer/Architect from manufacturer's full range.

4. Panel Coverage: 12 inches.
5. Panel Height: 0.375 inch.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Sub-framing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or pre-molded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/8 inch thick.
2. Joint Sealant: ASTM C920; as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.4 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

2.5 FINISHES

A. Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Concealed Finish: White or light-colored acrylic or polyester backer finish.

PART 3 - EXECUTION

3.1 PREPARATION

A. Miscellaneous Supports: Install sub-framing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

1. Soffit Framing: Wire tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.

3.2 METAL PANEL INSTALLATION

A. Metal Soffit Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Apply panels and associated items true to line for neat and weathertight enclosure.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.

3.3 CLEANING

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074293

SECTION 074646 - FIBER-CEMENT SIDING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fiber-cement siding panels and trim boards.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For fiber-cement siding and soffit including related accessories.

1.3 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

C. Research/evaluation reports.

D. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FIBER-CEMENT SIDING

A. General: ASTM C1186, Type A, Grade II, fiber-cement board, non-combustible when tested according to ASTM E136; with a flame-spread index of 25 or less when tested according to ASTM E84.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. CertainTeed Corporation.
b. GAF.
c. James Hardie Building Products, Inc.
d. Nichiha Fiber Cement.

B. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C1186 by a qualified testing agency acceptable to authorities having jurisdiction.

C. Nominal Thickness: Not less than 5/16 inch.

D. Horizontal Pattern: Boards size to be 6-1/4” width for 5” exposure.

1. Texture: Wood grain.

E. Panels: Boards size to be 48” x 96”.

1. Texture: Smooth.

F. Trim Boards: 1x4 or 1x6 smooth boards.

G. Factory Priming: Manufacturer's standard acrylic primer.

H. Factory Finish: manufacturer’s factory finish, applied in a controlled environment with a multi-coat, heat cured finish, in one process by same manufacturer of the fiber cement siding product. Siding shall be packaged & protected from damage and shall include a pre-packaged touch-up kit.

I. Color: As selected by Engineer/Architect from manufacturer's full range of colors.

2.2 ACCESSORIES

A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.

B. Flashing: Provide aluminum flashing complying with Section 076200 "Sheet Metal Flashing and Trim" at window and door heads and where indicated.

1. Finish for Aluminum Flashing: Siliconized polyester coating.

C. Fasteners:

1. For fastening to wood, use siding nails of sufficient length to penetrate a minimum of 1 inch into substrate.
2. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch, or three screw-threads, into substrate.
3. For fastening fiber cement, use hot-dip galvanized fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

1. Install fasteners no more than 24 inches o.c.

B. Install joint sealants as specified in Section 079200 "Joint Sealants" and to produce a weathertight installation.

3.2 ADJUSTING AND CLEANING

A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.

B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION 074646

SECTION 075323 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Adhered ethylene-propylene-diene-terpolymer (EPDM) roofing system.
2. Mechanically fastened, ethylene-propylene-diene-terpolymer (EPDM) roofing system.
3. Substrate board.
4. Roof insulation.
5. Cover board.

1.2 PREINSTALLATION MEETINGS

A. Preliminary Conference: Conduct conference at location to be determined.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.

B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane terminations.
3. Flashing details at penetrations.
4. Tapered insulation, thickness, and slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane and fastening spacings and patterns for mechanically fastened roofing system.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

C. Samples: For the following products:

1. Roof membrane and flashings of color required.
2. Walkway pads or rolls, of color required.

D. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

a. Submit evidence of complying with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

B. Product Test Reports: For components of roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

C. Research reports.

D. Field Test Reports:
1. Fastener-pullout test results & manufacturer's revised requirements for fastener patterns.

E. Field quality-control reports.

F. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 20 years from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.

B. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746, ASTM D4272, or the Resistance to Foot Traffic Test in FM Approvals 4470.

C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:

1. Zone 1 (Roof Area Field): 25.15 lbf/sq. ft.
2. Zone 2 (Roof Area Perimeter): 39.76 lbf/sq. ft.

    a. Location: From roof edge to 3.9 feet inside roof edge.

3. Zone 3 (Roof Area Corners): 60.51 lbf/sq. ft.

    a. Location: 3.9 feet in each direction from the building corner.

D. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

1. Fire/Windstorm Classification: Class 1A-90.
2. Hail-Resistance Rating: FM Global Property Loss Prevention Data Sheet 1-34 MH.

E. SPRI's Directory of Roof Assemblies Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system and shall be listed in SPRI's Directory of Roof Assemblies for roof assembly identical for that specified for this Project.
1. Wind Uplift Load Capacity: 90 psf.

F. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings from an applicable testing agency.

G. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings from an applicable testing agency.

2.2 ETHYLENE-PROPYLENE-DIENE-TERPOLYMER (EPDM) ROOFING

A. Fabric-Backed EPDM Sheet: ASTM D4637/D4637M, Type III, nonreinforced, EPDM sheet, laminated to a nonwoven polyester fabric backing except at selvages with factory-applied seam tape.

1. Basis of design Manufacturer: Subject to compliance with requirements, provide products by one of the following or equal product by other manufacturers:

    a. Carlisle SynTec Incorporated.
2. Composite Thickness: 115 mils, nominal.
3. Exposed Face Color: Black

2.3 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: 60-mil-thick EPDM, partially cured or cured, according to application.

C. Protection Sheet: Epichlorohydrin or neoprene nonreinforced flexible sheet, 55 to 60 mils thick, recommended by EPDM manufacturer for resistance to hydrocarbons, non-aromatic solvents, grease, and oil.

D. Slip Sheet: ASTM D2178/D2178M, Type IV; glass fiber; asphalt-impregnated felt.

E. Slip Sheet: Manufacturer's standard of thickness required for application.

F. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

G. Low-Rise, Urethane, Fabric-Backed Membrane Adhesive: Roof system manufacturer's standard spray-applied, low-rise, two-component urethane adhesive formulated for compatibility and use with fabric-backed membrane roofing.

H. Seaming Material: Manufacturer's standard, synthetic-rubber polymer primer and 3-inch-wide minimum, butyl splice tape with release film.

I. Lap Sealant: Manufacturer's standard, single-component sealant, colored to match membrane roofing.

J. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.

K. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

L. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening components to substrate, and acceptable to roofing system manufacturer.

M. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, molded pipe boot flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

1. Provide white flashing accessories for white EPDM membrane roofing.

2. Provide black flashing accessories for black EPDM membrane roofing.

2.4 ROOF INSULATION

A. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Carlisle SynTec Incorporated.
    b. Hunter Panels.
    c. Johns Manville; a Berkshire Hathaway company.
2. Size: 48 by 96 inches.
3. Thickness:

    a. Base Layer: 2-1/2".
    b. Upper Layers: 2".

B. Tapered Insulation: Provide factory-tapered insulation boards where required by drawings.

1. Material: Match roof insulation.
2. Minimum Thickness: 1/4 inch.
3. Slope:

    a. Roof Field: 1/4 inch per foot unless otherwise indicated on Drawings.
    b. Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.

2.5 INSULATION ACCESSORIES

A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
1. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.

2.6 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads, approximately 3/16 inch thick and acceptable to roofing system manufacturer.

1. Size: Approximately 36 by 60 inches
2. Color: Contrasting with roof membrane.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

3.2 PREPARATION

A. Perform fastener-pullout tests according to roof system manufacturer's written instructions.

1. Submit test results within 24 hours of performing tests.

a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

3.3 INSTALLATION OF ROOFING, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.4 INSTALLATION OF INSULATION

A. Coordinate installing roofing system components, so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Metal Decking:

1. Install base layer of insulation with end joints staggered not less than 12 inches in adjacent rows and with long joints continuous at right angle to flutes of decking.

a. Locate end joints over crests of decking.
b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.

1) Trim insulation so that water flow is unrestricted.

e. Fill gaps exceeding 1/4 inch with insulation.
f. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
g. Loosely lay base layer of insulation units over substrate.
h. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.

1) Fasten insulation according to requirements in SPRI's Directory of Roof Assemblies for specified Wind Uplift Load Capacity.

2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install upper layers of insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.
   a. Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.
   b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
   c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
   d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
   e. Trim insulation so that water flow is unrestricted.
   f. Fill gaps exceeding 1/4 inch with insulation.
   g. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
   h. Loosely lay each layer of insulation units over substrate.
   i. Adhere each layer of insulation to substrate using adhesive according to SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29, as follows:
      1) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.5 ADHERED ROOFING INSTALLATION

A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll membrane roof membrane and allow to relax before installing.

C. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.

D. Accurately align roof membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

E. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.

F. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at the rate required by manufacturer and install fabric-backed roof membrane.

G. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeters.

H. Apply roof membrane with side laps shingled with slope of roof deck where possible.

I. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement.

1. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
2. Apply lap sealant and seal exposed edges of roofing terminations.
3. Apply a continuous bead of in-seam sealant before closing splice if required by roofing system manufacturer.

J. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape.

1. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
2. Apply lap sealant and seal exposed edges of roofing terminations.

K. Factory-Applied Seam Tape Installation: Clean and prime surface to receive tape.

1. Firmly roll side and end laps of overlapping roof membrane to ensure a watertight seam installation.
2. Apply lap sealant and seal exposed edges of roofing terminations.

L. Spread sealant or mastic bed over deck-drain flange at roof drains and securely seal roof membrane in place with clamping ring.

M. Adhere protection sheet over roof membrane at locations indicated.

3.6 INSTALLATION OF BASE FLASHING

A. Install sheet flashings and pre-formed flashing accessories and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.7 INSTALLATION OF WALKWAYS

A. Flexible Walkways: Install walkway products according to manufacturer's written instructions.

1. Install flexible walkways at the following locations:

a. Perimeter of each rooftop unit.
b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.

c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
d. Top and bottom of each roof access ladder.
e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
f. Locations indicated on Drawings.
g. As required by roof membrane manufacturer's warranty requirements.

2. Provide 6-inch clearance between adjoining pads.
3. Adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.8 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 075323

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Formed roof-drainage sheet metal fabrications.
2. Formed steep-slope roof sheet metal fabrications.
3. Formed wall sheet metal fabrications.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at a location to be determined.

1.3 ACTION SUBMITTALS

A. Product Data: For each of the following

1. Underlayment materials.
2. Elastomeric sealant.
3. Butyl sealant.
4. Epoxy seam sealer.

B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counter-flashings.
10. Include details of special conditions.
11. Include details of connections to adjoining work.

C. Samples: For each exposed product and for each color and texture specified, 12 inches long by actual width.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of coping and roof edge flashing that is ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved.

B. Evaluation Reports: For copings and roof edge flashing, from an agency acceptable to authority having jurisdiction showing compliance with ANSI/SPRI/FM 4435/ES-1.

C. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Special warranty.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1. For copings and roof edge flashings that are ANSI/SPRI/FM 4435/ES-1 tested and FM Approvals approved, shop shall be listed as able to fabricate required details as tested and approved.

1.7 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

    a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
    b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
    c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. Sheet Metal Standard for Copper: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

D. SPRI Wind Design Standard: Manufacture and install copings, roof edge flashings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:

1. Design Pressure: As indicated on Drawings.

E. FM Approvals Listing: Manufacture and install copings, roof edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with name of fabricator and design approved by FM Approvals.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Copper Sheet: ASTM B370, cold-rolled copper sheet, H00 or H01 temper.

1. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Hussey Copper Ltd.
   b. Revere Copper Products, Inc.
2. Non-patinated, Exposed Finish: Mill.

C. Aluminum Sheet: ASTM B209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
   1. Alclad Finish: Metallurgically bonded surfacing alloy on both sides, forming aluminum sheet with reflective luster.
   2. Factory Prime Coating: Where painting after installation is required, pretreat metal with white or light-colored, factory-applied, baked-on epoxy primer coat; minimum dry film thickness of 0.2 mil.
   3. Clear Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.
   4. Color Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

      a. Color: As selected by Engineer/Architect from full range of industry colors and color densities.
      b. Color Range: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

   5. Exposed Coil-Coated Finish:

      a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

   6. Color: As selected by Engineer/Architect from manufacturer's full range.
   7. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

2.3 UNDERLAYMENT MATERIALS

A. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.

B. Synthetic Underlayment: Laminated or reinforced, woven polyethylene or polypropylene, synthetic roofing underlayment; bitumen free; slip resistant; suitable for high temperatures over 220 deg F; and complying with physical requirements of ASTM D226/D226M for Type I and Type II felts.

   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

      a. Atlas EPS; a Division of Atlas Roofing Corporation.
      b. Intertape Polymer Group.
      c. Kirsch Building Products, LLC.
      d. SDP Advanced Polymer Products Inc.

C. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Carlisle WIP Products; a brand of Carlisle Construction Materials.
   b. GCP Applied Technologies Inc.
   c. Henry Company.
   d. Metal-Fab Manufacturing, a Drexel Metals Company.
   e. Owens Corning.
   f. Protecto Wrap Company.
   g. SDP Advanced Polymer Products Inc.

2. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F or lower.

D. Slip Sheet: Rosin-sized building paper, 3 lb/100 sq. ft. minimum.

2.4 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

   a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
   b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
   c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

2. Fasteners for Copper Sheet: Copper, hardware bronze or passivated Series 300 stainless steel.
3. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

C. Solder:

1. For Copper: ASTM B32, Grade Sn50, 50 percent tin and 50 percent lead.
2. For Stainless Steel: ASTM B32, Grade Sn96, with acid flux of type recommended by stainless steel sheet manufacturer.
3. For Zinc-Coated (Galvanized) Steel: ASTM B32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, non-sag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

E. Elastomeric Sealant: ASTM C920, elastomeric polyurethane or silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

2.5 FABRICATION, GENERAL

A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.

1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:

1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, non expansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

G. Seams:

1. Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
2. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
3. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters:

1. Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required.
2. Fabricate in minimum 96-inch-long sections.
3. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard, but with thickness not less than twice the gutter thickness.
4. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.
5. Accessories: Continuous, removable leaf screen with sheet metal frame and hardware cloth screen.

6. Gutters with Girth 16 to 20 Inches: Fabricate from the following materials:

    a. Aluminum: 0.040 inch thick.

B. Downspouts: Fabricate rectangular downspouts to dimensions indicated on Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.

1. Hanger Style: rectangular 2 piece bracket.
2. Fabricate from the following materials:

    a. Aluminum: 0.024 inch thick.

C. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape required, complete with outlet tubes, exterior flange trim, and built-in overflows. Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.

D. Splash Pans: Fabricate to dimensions and shape required and from the following materials:

1. Aluminum: 0.040 inch thick.

2.7 CONVENTIONAL-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof Edge Flashing (Gravel Stop) and Fascia Cap: Fabricate in minimum 96-inch-long but not exceeding 12-foot-long sections. Furnish with 6-inch-wide, joint cover plates. Shop fabricate interior and exterior corners.

1. Fabricate from the following materials:

a. Aluminum: 0.050 inch thick.

B. Copings: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, fasten and seal watertight. Shop fabricated interior and exterior corners.

1. Fabricate from the following materials:

a. Aluminum: 0.050 inch thick.

C. Base Flashing: Shop fabricated interior and exterior corners. Fabricate from the following materials:

1. Aluminum: 0.040 inch thick.

D. Counterflashing: Shop fabricated interior and exterior corners. Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.

E. Roof-Penetration Flashing: Fabricate from the following materials:

1. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.

2.8 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12-foot-long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings; and form with 2-inch-high, end dams. Fabricate from the following materials:

1. Copper: 16 oz./sq. ft.
2. Stainless Steel: 0.0156 inch thick.

B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch-high, end dams. Fabricate from the following materials:

1. Copper: 16 oz./sq. ft.
2. Aluminum: 0.032 inch thick.
3. Stainless Steel: 0.0156 inch thick.
4. Galvanized Steel: 0.022 inch thick.
5. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch thick.

C. Wall Expansion-Joint Cover: Fabricate from the following materials:

1. Copper: 16 oz./sq. ft.
2. Aluminum: 0.040 inch thick.
3. Stainless Steel: 0.0188 inch thick.
4. Galvanized Steel: 0.028 inch thick.
5. Aluminum-Zinc Alloy-Coated Steel: 0.028 inch thick.

PART 3 - EXECUTION

3.1 INSTALLATION OF UNDERLAYMENT

A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim.

1. Install in shingle fashion to shed water.
2. Lap joints not less than 2 inches.

B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, in accordance with manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.

1. Lap horizontal joints not less than 4 inches.
2. Lap end joints not less than 12 inches.

C. Self-Adhering, High-Temperature Sheet Underlayment:

1. Install self-adhering, high-temperature sheet underlayment, wrinkle free.
2. Prime substrate, if recommended by underlayment manufacturer.
3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.
5. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days.

D. Install slip sheet, wrinkle free, directly on substrate before installing sheet metal flashing and trim.

1. Install in shingle fashion to shed water.
2. Lapp joints not less than 4 inches.

3.2 INSTALLATION, GENERAL

A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.

1. Install fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, or sealant.
3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
5. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
6. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
8. Do not field cut sheet metal flashing and trim by torch.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of uncoated-aluminum and stainless steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.

1. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
3. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated.

a. Embed hooked flanges of joint members not less than 1 inch into sealant.
b. Form joints to completely conceal sealant.
c. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
d. Adjust setting proportionately for installation at higher ambient temperatures.

1) Do not install sealant-type joints at temperatures below 40 deg F.

2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.

1. Pre-tin edges of sheets with solder to width of 1-1/2 inches; however, reduce pre-tinning where pre-tinned surface would show in completed Work.
2. Do not solder metallic-coated steel and aluminum sheet.
3. Do not pre-tin zinc-tin alloy-coated copper.
4. Do not use torches for soldering.
5. Heat surfaces to receive solder, and flow solder into joint.

a. Fill joint completely.
b. Completely remove flux and spatter from exposed surfaces.

6. Stainless Steel Soldering:

a. Tin edges of uncoated sheets, using solder for stainless steel and acid flux.
b. Promptly remove acid-flux residue from metal after tinning and soldering.
c. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

7. Copper Soldering: Tin edges of uncoated sheets, using solder for copper.

H. Rivets: Rivet joints in uncoated aluminum or zinc where necessary for strength.

3.3 INSTALLATION OF ROOF-DRAINAGE SYSTEM

A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Hanging Gutters:

1. Join sections with riveted and soldered joints or joints sealed with sealant.

2. Provide for thermal expansion.
3. Attach gutters at eave or fascia to firmly anchor them in position.
4. Provide end closures and seal watertight with sealant.
5. Slope to downspouts.
6. Install gutter with expansion joints at locations indicated on Drawings, but not exceeding, 50 feet apart. Install expansion-joint caps.
7. Install continuous gutter screens on gutters with noncorrosive fasteners, removable for cleaning gutters.

C. Downspouts:

1. Join sections with 1-1/2-inch telescoping joints.
2. Provide hangers with fasteners designed to hold downspouts securely to walls.
3. Locate hangers at top and bottom and at approximately 60 inches o.c.
4. Provide elbows at base of downspout to direct water away from building.
5. Connect downspouts to underground drainage system.

D. Splash Pans:

1. Install where downspouts discharge on low-slope roofs.
2. Set in asphalt roofing cement or elastomeric sealant compatible with the substrate.

E. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated on Drawings. Lap joints minimum of 4 inches in direction of water flow.

3.4 INSTALLATION OF ROOF FLASHINGS

A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.

1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.
3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.

C. Copings:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated.

a. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 24-inch centers.
b. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch centers.

3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless steel draw band and tighten.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.

1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
2. Extend counterflashing 4 inches over base flashing.
3. Lap counterflashing joints minimum of 4 inches.

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.5 INSTALLATION OF WALL FLASHINGS

A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.

C. Reglets: Installation of reglets is specified in Section 033000 "Cast-in-Place Concrete."

3.6 INSTALLATION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 CLEANING

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

3.8 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Engineer/Architect.

END OF SECTION 076200

SECTION 077100 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Reglets and counter-flashings.

B. Preinstallation Conference: Conduct conference at a location to be determined.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For roof specialties.

   1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.

C. Samples: For each type of roof specialty and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For tests performed by a qualified testing agency.

B. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are FM Approvals listed for specified class and SPRI ES-1 tested to specified design pressure.

1.6 WARRANTY

A. Roofing-System Warranty: Roof specialties are included in warranty provisions in Section 075323 – “Ethylene-Propylene-Diene-Monomer”

B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. FM Approvals' Listing: Manufacture and install roof-edge specialties that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-120. Identify materials with FM Approvals' markings.

B. SPRI Wind Design Standard: Manufacture and install roof-edge specialties tested according to SPRI ES-1 and capable of resisting the following design pressures:

1. Design Pressure: 90 psf.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 REGLETS AND COUNTERFLASHINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Fry Reglet Corporation.
2. Metal-Era, Inc.
3. OMG, Inc.

B. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:

1. Zinc-Coated Steel: Nominal 0.028-inch thickness.
2. Formed Aluminum: 0.024 inch thick.
3. Stainless Steel: 0.0188 inch thick.
4. Copper: 16 oz./sq. ft.

5. Corners: Factory mitered and mechanically clinched and sealed watertight.
6. Concrete Type, Embedded: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.

C. Counter-flashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches and in lengths not exceeding 12 feet designed to snap into reglets or through-wall-flashing receiver and compress against base flashings with joints lapped, from the following exposed metal:

1. Zinc-Coated Steel: Nominal 0.028-inch thickness.
2. Formed Aluminum: 0.024 inch thick.
3. Stainless Steel: 0.0188 inch thick.
4. Copper: 16 oz./sq. ft.

D. Accessories:

1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

E. Zinc-Coated Steel Finish: Three-coat fluoropolymer.

1. Color: As selected by Architect from manufacturer's full range.

F. Aluminum Finish: Three-coat fluoropolymer.

1. Color: As selected by Architect from manufacturer's full range.

2.3 MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 coating designation.

B. Aluminum Sheet: ASTM B209, alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.

C. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.

D. Copper Sheet: ASTM B370, cold-rolled copper sheet, H00 or H01 temper.

2.4 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Carlisle WIP Products; a brand of Carlisle Construction Materials.
    b. Henry Company.
    c. Owens Corning.

2. Thermal Stability: ASTM D1970/D1970M; stable after testing at 240 deg F.
3. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F.

B. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

C. Slip Sheet: Rosin-sized building paper, 3-lb/100 sq. ft. minimum.

2.5 MISCELLANEOUS MATERIALS

A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:

1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
2. Fasteners for Copper Sheet: Copper, hardware bronze, or passivated Series 300 stainless steel.
3. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
4. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.
5. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A153/A153M or ASTM F2329.

B. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

C. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.

2.6 FINISHES

A. Coil-Coated Galvanized-Steel Sheet Finishes:

1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with ASTM A755/A755M and coating and resin manufacturers' written instructions.
    a. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat.

B. Coil-Coated Aluminum Sheet Finishes:

1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    a. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat.

PART 3 - EXECUTION

3.1 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

1. Apply continuously under copings, roof-edge specialties, and reglets and counter-flashings.
2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.

B. Slip Sheet: Install with tape or adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches.

3.2 INSTALLATION, GENERAL

A. Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
2. Provide uniform, neat seams with minimum exposure of solder and sealant.
3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
4. Torch cutting of roof specialties is not permitted.
5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum and stainless steel roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.

2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.

1. Space movement joints at a maximum of 12 feet with no joints within 18 inches of corners or intersections unless otherwise indicated on Drawings.
2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.

F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches; however, reduce pre-tinning where pre-tinned surface would show in completed Work. Tin edges of uncoated copper sheets using solder for copper. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

3.3 INSTALLATION OF REGLETS AND COUNTERFLASHINGS

A. Embedded Reglets: See Section 033000 "Cast-in-Place Concrete" and Section 042000 "Unit Masonry" for installation of reglets.

B. Counter-flashings: Insert counter-flashings into reglets or other indicated receivers; ensure that counter-flashings overlap 4 inches over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches and bed with butyl sealant. Fit counter-flashings tightly to base flashings.

3.4 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as roof specialties are installed.

END OF SECTION 077100

SECTION 077200 - ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof curbs.
2. Equipment supports.
3. Roof Hatches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory.

B. Shop Drawings: For roof accessories.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ROOF CURBS

A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, straight sides, and integrally formed deck-mounting flange at perimeter bottom.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Conn-Fab Sales, Inc.
    b. Roof Curb Systems.
    c. Roof Products, Inc.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Material: Aluminum sheet, 0.125 inch thick.

1. Finish: Two-coat fluoropolymer.
2. Color: As selected by Architect from manufacturer's full range.

D. Construction:

1. Curb Profile: Manufacturer's standard compatible with roofing system.
2. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
3. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
4. Top Surface: Level top of curb, with roof slope accommodated by sloping deck-mounting flange.
5. Sloping Roofs: Where roof slope exceeds 1:48, fabricate curb with perimeter curb height tapered to accommodate roof slope so that top surface of perimeter curb is level. Equip unit with water diverter or cricket on side that obstructs water flow.
6. Insulation: Factory insulated with 1-1/2-inch- thick glass-fiber board insulation.
7. Liner: Same material as curb, of manufacturer's standard thickness and finish.
8. Nailer: Factory-installed wood nailer under top flange on side of curb, continuous around curb perimeter.
9. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb, of size and spacing required to meet wind uplift requirements.
10. Platform Cap: Where portion of roof curb is not covered by equipment, provide weathertight platform cap formed from 3/4-inch-thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
11. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.
12. Damper Tray: Provide damper tray or shelf with opening 3 inches.

2.2 EQUIPMENT SUPPORTS

A. Equipment Supports: Internally reinforced perimeter metal equipment supports capable of supporting superimposed live and dead loads between structural supports, including equipment loads and other construction indicated on Drawings, spanning between structural supports; capable of meeting performance requirements; with welded corner joints, integral metal cant, and integrally formed structure-mounting flange at bottom.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Conn-Fab Sales, Inc.
    b. Roof Curb Systems.
    c. Roof Products, Inc.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Material: Aluminum sheet, 0.125 inch thick.

1. Finish: Two-coat fluoropolymer.
2. Color: As selected by Architect from manufacturer's full range.

D. Construction:

1. Curb Profile: Manufacturer's standard compatible with roofing system.
2. Insulation: Factory insulated with 1” thick glass-fiber board insulation.
3. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.
4. Nailer: Factory-installed continuous wood nailers 5-1/2 inches wide under top flange on side of curb, continuous around support perimeter.
5. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb of size and spacing required to meet wind uplift requirements.
6. Platform Cap: Where portion of equipment support is not covered by equipment, provide weathertight platform cap formed from 3/4-inch-thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
7. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.
8. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
9. Fabricate equipment supports to minimum height of 12 inches above roofing surface unless otherwise indicated.
10. Sloping Roofs: Where roof slope exceeds 1:48, fabricate each support with height to accommodate roof slope so that tops of supports are level with each other. Equip supports with water diverters or crickets on sides that obstruct water flow.

2.3 ROOF HATCHES

A. Roof Hatches: Metal roof-hatch units with lids and insulated double-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, straight sides, and integrally formed deck-mounting flange at perimeter bottom.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Babcock-Davis.
b. BILCO Company (The).

2. Type and Size: Single-leaf lid, NB series 30” x 54”.
3. Loads: Minimum 40-lbf/sq. ft. external live load and 30-lbf/sq. ft. internal uplift load.

a. When release is actuated, lid shall open against 10-lbf/sq. ft. snow or wind load and lock in position.

4. Curb, Framing, and Lid Material: Zinc-coated (galvanized) or Aluminum-zinc alloy-coated steel sheet.

a. Thickness: Manufacturer's standard thickness for hatch size indicated.
b. Finish: Two-coat fluoropolymer.
c. Color: As selected by Architect from manufacturer's full range.

5. Curb, Framing, and Lid Material: Aluminum sheet.

a. Thickness: Manufacturer's standard thickness for hatch size indicated.
b. Finish: Two-coat fluoropolymer.
c. Color: As selected by Architect from manufacturer's full range.

6. Construction:

a. Insulation: 1-inch-thick, cellulosic-fiber board or 1-inch-thick, glass-fiber board.

1) R-Value: 2.78 according to ASTM C1363.

b. Nailer: Factory-installed wood nailer continuous around hatch perimeter.
c. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
d. Exterior Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
e. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
f. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is tapered to accommodate roof slope so that top surfaces of perimeter curb are level. Equip hatch with water diverter or cricket on side that obstructs water flow.
g. Security Grille: Provide where indicated on Drawings.

2.4 METAL MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 coating designation and mill phosphatized for field painting where indicated.
1. Exposed Coil-Coated Finish: Pre-painted by the coil-coating process to comply with ASTM A755/A755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight.

2. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils.
3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

B. Aluminum Sheet: ASTM B209, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.
1. Exposed Coil-Coated Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Two-Coat Fluoropolymer Finish: AAMA 2605. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight.
2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

C. Aluminum Extrusions and Tubes: ASTM B221, manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.

D. Stainless Steel Sheet and Shapes: ASTM A240/A240M or ASTM A666, Type 304.

E. Steel Shapes: ASTM A36/A36M, hot-dip galvanized according to ASTM A123/A123M unless otherwise indicated.

F. Steel Tube: ASTM A500/A500M, round tube.

G. Galvanized-Steel Tube: ASTM A500/A500M, round tube, hot-dip galvanized according to ASTM A123/A123M.

H. Steel Pipe: ASTM A53/A53M, galvanized.

2.5 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Cellulosic-Fiber Board Insulation: ASTM C208, Type II, Grade 1, thickness as indicated.

C. Glass-Fiber Board Insulation: ASTM C726, nominal density of 3 lb/cu. ft., thermal resistivity of 4.3 deg F x h x sq. ft./Btu x in. at 75 deg F, thickness as indicated.

D. Polyisocyanurate Board Insulation: ASTM C1289, thickness and thermal resistivity as indicated.

E. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches thick.

F. Underlayment:

1. Felt: ASTM D226/D226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
2. Polyethylene Sheet: 6-mil-thick polyethylene sheet complying with ASTM D4397.
3. Slip Sheet: Building paper, 3 lb/100 sq. ft. minimum, rosin sized.
4. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

G. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:

H. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

I. Elastomeric Sealant: ASTM C920, elastomeric polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

J. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

K. Asphalt Roofing Cement: ASTM D4586/D4586M, asbestos free, of consistency required for application.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify dimensions of roof openings for roof accessories. Install roof accessories according to manufacturer's written instructions.

1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum or stainless steel roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.

C. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.2 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A780/A780M.

B. Clean exposed surfaces according to manufacturer's written instructions.

C. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077200

SECTION 077253 - SNOW GUARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fence-type, seam-mounted snow guards.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include roof plans showing layouts and attachment details of snow guards.

1. Include details of rail-type snow guards.

C. Samples:

1. Fence Type Snow Guards: Bracket, 12-inch-long rail, and installation hardware.

a. For units with factory-applied finishes, submit manufacturer's standard color selections.

D. Delegated-Design Submittal: For snow guards, include analysis reports signed and sealed by the qualified professional engineer responsible for their preparation.

1. Include calculation of number and location of snow guards.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that the engineer is licensed in the state in which the Project is located.

B. Product Test Reports: For each type of snow guard, for tests performed by a qualified testing agency, indicating load at failure of attachment to roof system identical to roof system used on this Project.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design snow guards, including attachment to roofing material and roof deck, applicable for attachment method, based on the following:

1. Roof snow load.
2. Snow drifting
3. Roof slope.
4. Roof type.
5. Roof dimensions.
6. Roofing substrate type and thickness.
7. Snow guard type.
8. Snow guard fastening method and strength.
9. Snow guard spacing.
10. Coefficient of Friction Between Snow and Roof Surface: 0.
11. Factor of Safety: 3.

B. Performance Requirements: Provide snow guards that withstand exposure to weather and resist thermally induced movement without failure, rattling, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

C. Structural Performance: Snow guards shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Snow Loads: As indicated on Drawings.

2.2 FENCE-TYPE SEAM MOUNTED SNOW GUARDS

A. Basis of Design: SnowMax fence-style, seam-mounted snow guard and standing seam mounting bracket system with Lite-Bar and Lite Splices to be color matched to standing seam metal roofing as manufactured by Alpine SnowGuards, a division of Vermont Slate & Copper Services, Inc.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Metal Roof Innovations, Ltd.
b. SnoBlox-Snojax

2. Description: Fence style snow guards shall be fabricated from metal extrusions, anchored to brackets and equipped with metal strips installed in an integral track to accept color-matching inserts of material and finish used for the standing seam metal roof.
3. Brackets and Baseplates: ASTM B209 aluminum; mill finish.
4. Fence extrusion: ASTM B221 aluminum; mill finish.

a. Profile: Manufacturer’s standard extrusion.

5. Seam clamps: ASTM B221 aluminum extrusion or ASTM B85/B85M aluminum casting with stainless steel set screws incorporating round nonpenetrating point; designed for use with applicable roofing system to which clamp is attached.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install snow guards according to manufacturer's written instructions.

1. Space rows as indicated on Shop Drawings.
2. Space rows as recommended by manufacturer.

B. Attachment for Standing-Seam Metal Roofing:

1. Do not use fasteners that will penetrate metal roofing or fastening methods that void metal roofing finish warranty.

2. Fence-Type, Seam-Mounted Snow Guards:

a. Install brackets to vertical ribs in straight rows.
b. Secure with stainless steel set screws, incorporating round nonpenetrating point, on same side of standing seam.
c. Torque set screw according to manufacturer's instructions.
d. Install cross members to brackets.
e. Install snow clips to cross members.

END OF SECTION 077253

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.
2. Penetrations in horizontal assemblies.
3. Penetrations in smoke barriers.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

1.5 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Approval according to FM Approval 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:

    a. Penetration firestopping systems shall bear the classification marking of a qualified testing agency.

        1) UL in its "Fire Resistance Directory."
        2) Intertek Group in its "Directory of Listed Building Products."
        3) FM Approval in its "Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. 3M Fire Protection Products.
    b. A/D Fire Protection Systems Inc.
    c. Construction Solutions.
    d. Grabber Construction Products.
    e. Hilti, Inc.
    f. HOLDRITE.
    g. NUCO Inc.
    h. Passive Fire Protection Partners.
    i. RectorSeal.
    j. Specified Technologies, Inc.
    k. STC Sound Control.
    l. Tremco, Inc.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.

E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.

F. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

C. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

D. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.

2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.3 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2174.

B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 078413

SECTION 079100 - PREFORMED JOINT SEALS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preformed, foam joint seals.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at the Project site.

1.3 ACTION SUBMITTALS

A. Product data.

B. Samples: Manufacturer's color sheets, showing full range of available colors for each type of exposed preformed joint seal.

C. Preformed joint seal schedule.

1.4 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports:

1. Product Test Reports: For each preformed joint seal, for tests performed by manufacturer and witnessed by a qualified testing agency.

B. Sample warranties.

1.5 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace preformed joint seals that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish preformed joint seals to repair or replace those that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PREFORMED, FOAM JOINT SEALS

A. Preformed, Foam Joint Seals: Manufacturer's standard joint seal manufactured from urethane or EVA (ethylene vinyl acetate) foam with minimum density of 10 lb/cu. ft. and impregnated with a nondrying, water-repellent agent. Factory produce them in precompressed sizes in roll or stick form to fit joint widths based on design criteria indicated, with factory- or field-applied adhesive for bonding to substrates.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Inpro Architectural Products

2. Intek Construction Products by MM Systems Corp.

3. Sika Corporation

4. Design Criteria:

   a. Nominal Joint Width: 1-2 inches, see drawings.
   b. Minimum Joint Width: 1 inch.
   c. Maximum Joint Width: 3 inches.

5. Joint Seal Color: As selected by Architect from full range of industry colors.

2.2 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by preformed joint seal manufacturer for joint substrates indicated.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to preformed joint seal manufacturer, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces and formulated to promote best adhesion to joint substrates.

C. Masking Tape: Nonstaining, non-absorbent material compatible with preformed joint seals and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing preformed joint seals to comply with preformed joint seal manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of preformed joint seal, including dust, paints (except for permanent protective coatings tested and approved for seal adhesion and compatibility by seal manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean, porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimal bond with preformed joint seals. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.
    d. Exterior insulation and finish systems.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint seals. Nonporous joint substrates include the following:

    a. Metal.
    b. Glass.
    c. Porcelain enamel.
    d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by preformed joint seal manufacturer or as indicated by tests or prior experience. Apply primer to comply with joint seal manufacturer's written instructions. Confine primers to areas of joint seal bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of adhesive or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove smears. Remove tape immediately after tooling without disturbing joint seal.

3.2 INSTALLATION

A. General: Comply with preformed joint seal manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Installation of Preformed, Foam Joint Seals:

1. Install each length of seal immediately after removing protective wrapping.
2. Firmly secure compressed joint seals to joint gap side to obtain full bond using exposed pressure-sensitive adhesive or field-applied adhesive as recommended by manufacturer.
3. Do not pull or stretch material. Produce seal continuity at splices, ends, turns, and intersections of joints.
4. For applications at low ambient temperatures, heat foam joint seal material in compliance with manufacturer's written instructions.

3.3 PROTECTION

A. Protect preformed joint seals from damage resulting from construction operations or other causes so seals are without deterioration or damage at time of Substantial Completion.

B. Cut out, remove, and repair damaged or deteriorated seals so repaired areas are indistinguishable from original work.

END OF SECTION 079100

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nonstaining silicone joint sealants.
2. Urethane joint sealants.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at a location to be determined.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Samples: For each kind and color of joint sealant required.

C. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Preconstruction laboratory test reports.

C. Preconstruction field-adhesion-test reports.

D. Field-adhesion-test reports.

E. Sample warranties.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C1021 to conduct the testing indicated.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.
3. Stain Testing: Use ASTM C1248 to determine stain potential of sealant when in contact with stone or masonry substrates.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates. Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.

1.7 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Colors of Exposed Joint Sealants: As selected by Engineer/Architect from manufacturer's full range.

2.2 NONSTAINING SILICONE JOINT SEALANTS

A. Silicone, Nonstaining, S, NS, 100/50, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. May National Associates, Inc.; a subsidiary of Sika Corporation.

b. Pecora Corporation.
c. Sika Corporation; Joint Sealants.
d. Tremco Incorporated.

2.3 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 100/50, T, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Uses T and NT.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Sika Corporation; Joint Sealants.

2.4 JOINT-SEALANT BACKING

A. Cylindrical Sealant Backings: ASTM C1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Adfast.
b. Alcot Plastics Ltd.
c. BASF Corporation.
d. Construction Foam Products; a division of Nomaco, Inc.

B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.5 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove laitance and form-release agents from concrete.
2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.2 INSTALLATION OF JOINT SEALANTS

A. General: Comply with ASTM C1193 and joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

1. Provide concave joint profile per Figure 8A in ASTM C1193 unless otherwise indicated.

3.3 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:

a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.4 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces JS-1.

1. Joint Locations:

a. Construction joints in cast-in-place concrete.
b. Joints between plant-precast architectural concrete units.
c. Control and expansion joints in unit masonry.
d. Joints in dimension stone cladding.
e. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
3. Joint-Sealant Color: As selected by Engineer/Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Concealed mastics JS-2.

1. Joint Locations:

a. Aluminum thresholds.
b. Sill plates.
c. Other joints as indicated on Drawings.
d. Gutters.

2. Joint Sealant: Urethane based.
3. Joint-Sealant Color: As selected by Engineer/Architect from manufacturer's full range of colors.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.
3. Interior custom hollow-metal doors and frames.
4. Exterior custom hollow-metal doors and frames.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.

D. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Field quality control reports.

1.5 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.6 QUALITY ASSURANCE

A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:

1. Door & Hardware Institute Fire & Egress Door Assembly Inspector (FDAI) certification.

B. Egress Door Inspector Qualifications: Inspector for field quality control inspections of egress door assemblies shall meet the qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:

1. Door & Hardware Institute Fire & Egress Door Assembly Inspector (FDAI) certification.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Ceco Door; ASSA ABLOY.
2. Curries Company; ASSA ABLOY.
3. Steelcraft; Allegion.
4.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.

B. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

C. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.48 when tested according to ASTM C518.

2.3 INTERIOR STANDARD STEEL DOORS AND KNOCK DOWN FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Standard-Duty Doors and Knock Down Frames: ANSI/SDI A250.8, Level 1; ANSI/SDI A250.4, Level C. At locations indicated in the Door and Frame Schedule.

1. Doors:

   a. Type: As indicated in the Door and Frame Schedule.
   b. Thickness: 1-3/4 inches or 1-3/8 inches.
   c. Face: Metallic-coated steel sheet, minimum thickness of 0.040 inch.
   d. Edge Construction: Model 1, Full Flush.
   e. Core: Manufacturer's standard.
   f. Fire-Rated Core: Manufacturer's standard laminated mineral board core for fire-rated and temperature-rise-rated doors.

2. Frames:

   a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch.
   b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
   c. Construction: Knocked down.

2.4 HEAVY DUTY DOORS AND WELDED FRAMES

A. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B. At locations indicated in the Door and Frame Schedule.

1. Doors:

   a. Type: As indicated in the Door and Frame Schedule.
   b. Thickness: 1-3/4 inches.
   c. Face: Metallic-coated steel sheet, minimum thickness of 0.040 inch.
   d. Edge Construction: Model 2, Seamless.
   e. Core: Manufacturer's standard.
   f. Fire-Rated Core: Manufacturer's standard laminated mineral board core for fire-rated and temperature-rise-rated doors.

2. Frames:

   a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch.
   b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.

c. Construction: Full profile welded.

2.5 EXTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B. At locations indicated in the Door and Frame Schedule.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches.
c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch, with minimum A60 coating.
d. Edge Construction: Model 2, Seamless.
e. Edge Bevel: Bevel lock edge 1/8 inch in 2 inches.
f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
g. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
h. Core: Polyisocyanurate.
i. Fire-Rated Core: Manufacturer's standard laminated mineral board core for fire-rated doors.

2. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A60 coating.
b. Construction: Thermal break frames.

2.6 BORROWED LITES

A. Fabricate of metallic-coated steel sheet, minimum thickness of 0.053 inch.

B. Construction: Full profile welded.

C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.

D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.7 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.
3. Postinstalled Expansion Anchor: Minimum 3/8-inch-diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at top of underlayment.

D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized according to ASTM A153/A153M, Class B.

2.8 MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

C. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

D. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.

F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

G. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

H. Glazing: Comply with requirements in Section 088000 "Glazing."

2.9 FABRICATION

A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding, or by rigid mechanical anchors.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to ANSI/SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

2.10 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

    a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
    b. Install frames with removable stops located on secure side of opening.

2. Fire-Rated Openings: Install frames according to NFPA 80.
3. Floor Anchors: Secure with post-installed expansion anchors.

    a. Floor anchors may be set with power-actuated fasteners instead of post-installed expansion anchors if so indicated and approved on Shop Drawings.

4. Solidly pack mineral-fiber insulation inside exterior frames.
5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.

6. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

B. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.

C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

A. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated door according to NFPA 80, Section 5.2.
2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements according to NFPA 101, Section 7.2.1.15.

B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

C. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

D. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 REPAIR

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

C. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Five-ply flush wood veneer-faced doors for transparent finish.
2. Factory priming and finishing flush wood doors and frames.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Door core materials and construction.
2. Door edge construction
3. Door face type and characteristics.
4. Door trim for openings.
5. Door frame construction.
6. Factory-machining criteria.
7. Factory-priming and finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

1. Door schedule indicating door and frame location, type, size, fire protection rating, and swing.
2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
3. Details of frame for each frame type, including dimensions and profile.
4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
5. Dimensions and locations of blocking for hardware attachment.
6. Clearances and undercuts.
7. Requirements for veneer matching.
8. Apply AWI Quality Certification Program label to Shop Drawings.

C. Samples: For factory-finished doors and factory-finished door frames.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For door inspector.

1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.

2. Egress Door Inspector: Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.
3. Submit copy of DHI's Fire and Egress Door Assembly Inspector (FDAI) certificate.

B. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.5 QUALITY ASSURANCE

A. Manufacturer's Certification: Licensed participant in AWI's Quality Certification Program.

B. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies shall comply with qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:

1. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.

C. Egress Door Inspector Qualifications: Inspector for field quality-control inspections of egress door assemblies shall comply with qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:

1. DHI's Fire and Egress Door Assembly Inspector (FDAI) certification.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Wood Door and Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings and temperature-rise limits indicated on Drawings, based on testing at positive pressure in accordance with UL 10C or NFPA 252.

1. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.

B. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.

2.2 FLUSH WOOD DOORS AND FRAMES, GENERAL

A. Quality Standard: In addition to requirements specified, comply with ANSI/WDMA I.S. 1A.

1. Provide labels and certificates from AWI WI certification program indicating that doors and frames comply with requirements of grades specified.
   a. Contractor shall register the Work under this Section with the AWI Quality Certification Program at www.awiqcp.org or by calling 855-345-0991.

2.3 SOLID-CORE, FIVE-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Exterior Doors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eggers Industries.
   b. Lambton Doors.
   c. Oshkosh Door Company.
   d. VT Industries Inc.
2. Performance Grade: ANSI/WDMA I.S. 1A Extra Heavy Duty.
3. ANSI/WDMA I.S. 1A Grade: Premium.
4. Faces: Single-plywood veneer not less than 1/50 inch thick.

   a. Species: Red oak.
   b. Cut: Plain sliced (flat sliced).
   c. Match between Veneer Leaves: Book match.
   d. Assembly of Veneer Leaves on Door Faces: Center-balance match.
   e. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.

5. Exposed Vertical and Top Edges: Same species as faces - Architectural Woodwork Standards edge Type A.
6. Core:
   a. Glued wood stave.
   b. WDMA I.S. 10 structural composite lumber.

      1) Screw Withdrawal, Door Face: 550 lbf.
      2) Screw Withdrawal, Vertical Edge: 550 lbf.

   c. Either glued wood stave or WDMA I.S. 10 structural composite lumber.

7. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

8. Adhesives: Type I in accordance with WDMA T.M. 6.

B. Interior Doors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Eggers Industries.
    b. Lambton Doors.
    c. Oshkosh Door Company.
    d. VT Industries Inc.
2. Performance Grade: ANSI/WDMA I.S. 1A Extra Heavy Duty.

3. ANSI/WDMA I.S. 1A Grade: Premium.
4. Faces: Single-plywood veneer not less than 1/50 inch thick.

    a. Species: Red oak.
    b. Cut: Plain sliced (flat sliced).
    c. Match between Veneer Leaves: Book match.
    d. Assembly of Veneer Leaves on Door Faces: Center-balance match.
    e. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
    f. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
    g. Blueprint Match: Where indicated, provide doors with faces produced from same flitches as adjacent wood paneling and arranged to provide blueprint match with wood paneling. Comply with requirements in Section 062023 "Interior Finish Carpentry."

5. Exposed Vertical and Top Edges: Same species as faces - Architectural Woodwork Standards edge Type A.

    a. Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

        1) Screw-Holding Capability: 550 lbf in accordance with WDMA T.M. 10.

6. Core for Non-Fire-Rated Doors:

    a. ANSI A208.1, Grade LD-2 particleboard.

        1) Provide doors with glued wood-stave or WDMA I.S. 10 structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit devices in Section 087100 "Door Hardware."

    b. Glued wood stave.
    c. WDMA I.S. 10 structural composite lumber.

        1) Screw Withdrawal, Face: 550 lbf.
        2) Screw Withdrawal, Edge: 550 lbf.

d. Either glued wood stave or WDMA I.S. 10 structural composite lumber.

7. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

2.4 LIGHT FRAMES AND LOUVERS

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.

1. Wood Species: Same species as door faces.
2. Profile: Flush rectangular beads.
3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

B. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated on Drawings. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.

C. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch-thick, cold-rolled steel sheet; factory primed for paint with baked-enamel- or powder-coated finish; and approved for use in doors of fire-protection rating indicated on Drawings.

2.5 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated.

1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
2. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied.

1. Locate hardware to comply with DHI-WDHS-3.
2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
5. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.

2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."
3. Louvers: Factory install louvers in prepared openings.

2.6 FACTORY PRIMING

A. Doors for Opaque Finish: Factory prime faces, all four edges, edges of cutouts, and mortises with one coat of wood primer specified in Section 099113 "Exterior Painting." Or Section 099123" Interior Painting."

2.7 FACTORY FINISHING

A. Comply with referenced quality standard for factory finishing.

1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
2. Finish faces, all four edges, edges of cutouts, and mortises.
3. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.

B. Factory finish doors.

C. Transparent Finish:

1. ANSI/WDMA I.S. 1A Grade: Premium.
2. Finish: Architectural Woodwork Standards System-9, UV Curable, Acrylated Epoxy, Polyester or Urethane.
3. Staining: As selected by Engineer/Architect from manufacturer's full range.
4. Effect: Semi-filled finish, produced by applying an additional finish coat to partially fill the wood pores.
5. Sheen: Satin.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Install doors and frames to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

C. Install frames level, plumb, true, and straight.

1. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
2. Anchor frames to anchors or blocking built in or directly attached to substrates.

a. Secure with countersunk, concealed fasteners and blind nailing.

b. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.

1) For factory-finished items, use filler matching finish of items being installed.

3. Install fire-rated doors and frames in accordance with NFPA 80.
4. Install smoke- and draft-control doors in accordance with NFPA 105.

D. Job-Fitted Doors:

1. Align and fit doors in frames with uniform clearances and bevels as indicated below.

a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.

2. Machine doors for hardware.
3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
4. Clearances:

a. Provide 1/8 inch at heads, jambs, and between pairs of doors.
b. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
c. Where threshold is shown or scheduled, provide1/4 inch from bottom of door to top of threshold unless otherwise indicated.
d. Comply with NFPA 80 for fire-rated doors.

5. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
6. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.

E. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

F. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.2 FIELD QUALITY CONTROL

A. Inspections:

1. Provide inspection of installed Work through AWI's Quality Certification Program, certifying that wood doors and frames, including installation, comply with requirements of AWI/AWMCA/WI's "Architectural Woodwork Standards" for the specified grade.
2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.

B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

C. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

D. Prepare and submit separate inspection reports for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 081613 – FIBERGLASS DOORS AND FIBERGLASS FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes:

1. Interior fiberglass doors and fiberglass frames.
2. Exterior fiberglass doors and fiberglass frames.
3. Fire Rated Fiberglass doors and fiberglass frames.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

C. Shop Drawings: Include the following:

1. Elevations of each door type and each frame type.
2. Details of doors, including vertical and horizontal edge details and fiberglass thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.

D. Product Schedule: For fiberglass doors and fiberglass frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Field quality control reports.

1.5 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.6 QUALITY ASSURANCE

A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

B. Egress Door Inspector Qualifications: Inspector for field quality control inspections of egress door assemblies shall meet the qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:

1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
2. Temperature-Rise Limit: At vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.

B. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

C. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.48 when tested according to ASTM C518.

2.2 INTERIOR FIBERGLASS DOORS AND FIBERGLASS FRAMES

A. Basis of Design: AF-217 Pebble Grain textured All Fiberglass Door as manufactured by Special-Lite, Inc.

B. Manufacturers: Subject to compliance with requirements, other available manufacturers offering products that may be incorporated into the Work, will be reviewed for conformance to the specifications and requirements contained herein.

C. Construct fiberglass doors and fiberglass frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

D. Heavy-Duty Doors and Chemically Welded Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B. At locations indicated in the Door and Frame Schedule.

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches or 1-3/8 inches.
c. Face: 0.0120 pebble grain texture, through color FRP sheet, bonded to core with adhesive.
d. Rails: Top Rail, 6” minimum pultruded fiberglass with 0.090” thick edge to match door face. Bottom Rail, 4” minimum pultruded fiberglass with 0.090” thick edge to match door face.
e. Core: Manufacturer's standard polypropylene honeycomb core.

2. Frames:

a. Materials: Pultruded Fiberglass, wall thickness of 1/4 inch.
b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
c. Construction: Chemically welded AF-150 frame.

2.3 EXTERIOR FIBERGLASS DOORS AND FIBERGLASS FRAMES

A. Exterior Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B. At locations indicated in the Door and Frame Schedule.

1. Doors:
a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches or 1-3/8 inches.
c. Face: 0.0120 pebble grain texture, through color FRP sheet, bonded to core with adhesive.
d. Rails: Top Rail, 6” minimum pultruded fiberglass with 0.090” thick edge to match door face. Bottom Rail, 4” minimum pultruded fiberglass with 0.090” thick edge to match door face.
e. Insulated Core: Manufacturer's standard insulated core for exterior door.

2. Frames:

a. Materials: Pultruded Fiberglass, wall thickness of 1/4 inch.
b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
c. Construction: Chemically welded AF-150 frame and insulated.

2.4 FIRE RATED FIBERGLASS DOORS AND FIBERGLASS FRAMES

A. Basis of Design: AF-217 Pebble Grain textured All Fiberglass Fire Rated Door as manufactured by Special-Lite, Inc.

B. Fire Rated Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B. At locations indicated in the Door and Frame Schedule.

1. Doors:
   a. Type: As indicated in the Door and Frame Schedule.
   b. Thickness: 1-3/4 inches or 1-3/8 inches.
   c. Face: 0.0120 pebble grain texture, through color FRP sheet, bonded to core with adhesive.
   d. Rails: Top Rail, 6” minimum pultruded fiberglass with 0.090” thick edge to match door face. Bottom Rail, 4” minimum pultruded fiberglass with 0.090” thick edge to match door face.
   e. Insulated Core: Manufacturer's standard mineral board core for fire-rated required.

2. Frames:

   a. Materials: Pultruded Fiberglass, wall thickness of 1/4inch.
   b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
   c. Construction: Chemically welded AF-150 FR frame.

2.5 BORROWED LITES

A. Pultruded Fiberglass sheet, wall thickness of 1/4 inch.

B. Construction: Full profile welded.

C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.

D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.6 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.

3. Postinstalled Expansion Anchor: Minimum 3/8-inch-diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at top of underlayment.

D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized according to ASTM A153/A153M, Class B.

2.7 ACCESSORIES

A. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.

B. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

C. Glazing: Comply with requirements in Section 088000 "Glazing."

2.8 FABRICATION

A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

B. Chemically Welded Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding, or by rigid mechanical anchors.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

C. Hardware Preparation: Factory prepare fiberglass doors and fiberglass frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising,

drilling, and tapping according to ANSI/SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

2.9 FIBERGLASS FINISHES

A. Two-component acrylic urethane Gloss topcoat.

B. Color to be selected by Architect from manufacturer’s full

C. Low VOC, Gloss coating.

D. High solids, high build, multifunctional coating with excellent chemical resistance.

2.10 FIBERGLASS FINISHES

A. Finish: High-Performance Organic Finish (Two-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard two-coat, thermo-cured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Engineer/Architect from full range of industry colors and color densities.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. Pultruded Fiberglass Frames: Comply with ANSI/SDI A250.11.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

    a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
    b. Install frames with removable stops located on secure side of opening.

2. Fire-Rated Openings: Install frames according to NFPA 80.
3. Floor Anchors: Secure with postinstalled expansion anchors.

    a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

4. Solidly pack mineral-fiber insulation inside exterior frames.
5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.

6. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

B. Fiberglass Doors: Fit and adjust fiberglass doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Fiberglass Doors: Comply with ANSI/SDI A250.8.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

3. Smoke-Control Doors: Install doors according to NFPA 105.

C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with fiberglass door manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

A. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated door according to NFPA 80, Section 5.2.
2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements according to NFPA 101, Section 7.2.1.15.

B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

C. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

D. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 REPAIR

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

B. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081613

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes access doors and frames for walls and ceilings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each type of access door and frame and for each finish specified.

C. Product Schedule: For access doors and frames.

1.3 CLOSEOUT SUBMITTALS

A. Record Documents: For access door locations, list of applicable room name and number in which access door is located.

1.4 QUALITY ASSURANCE

A. Fire-Rated Door Inspector Qualifications: Inspector for field quality control inspections of fire-rated door assemblies shall meet the qualifications set forth in NFPA 80, section 5.2.3.1 and the following:

1. Door & Hardware Institute Fire & Egress Door Assembly Inspector (FDAI) certification.

PART 2 - PRODUCTS

2.1 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Exposed Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Babcock-Davis.
b. JL Industries, Inc.; a division of the Activar Construction Products Group.
c. Karp Associates, Inc.
d. Larsens Manufacturing Company.

2. Description: Face of door flush with frame, with exposed flange and concealed hinge.

3. Locations: Wall and ceiling.
4. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch, 16 gage, factory finished.
5. Frame Material: Same material, thickness, and finish as door.
6. Latch and Lock: Cam latch, screwdriver operated with interior release.

B. Flush Access Doors with Concealed Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Babcock-Davis.
   b. JL Industries, Inc.; a division of the Activar Construction Products Group.
   c. Karp Associates, Inc.
   d. Larsens Manufacturing Company.

2. Description: Face of door flush with frame; with concealed flange for gypsum board installation and concealed hinge.
3. Locations: Wall and ceiling.
4. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch, 16 gage factory finished.
5. Frame Material: Same material and thickness as door.
6. Latch and Lock: Cam latch, screwdriver operated with interior release.

2.2 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.

D. Stainless Steel Plate, Sheet, and Strip: ASTM A240/A240M or ASTM A666, Type 304. Remove tool and die marks and stretch lines, or blend into finish.

E. Stainless Flat Bars: ASTM A666, Type 304. Remove tool and die marks and stretch lines, or blend into finish.

F. Frame Anchors: Same material as door face.

G. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.3 FABRICATION

A. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

B. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.

C. Latch and Lock Hardware:

1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
2. Keys: Furnish two keys per lock and key all locks alike.
3. Mortise Cylinder Preparation: Where indicated, prepare door panel to accept cylinder specified in Section 087100 "Door Hardware," in locations that are accessible to public.
4. Flush mounted, keyless paddle latch with finger pull in secured spaces and mechanical rooms.

2.4 FINISHES

A. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
2. Factory Finished: Apply manufacturer's standard baked-enamel or powder-coat finish immediately after cleaning and pretreating, with minimum dry-film thickness of 1 mil for topcoat.

a. Color: As selected by Engineer/Architect from full range of industry colors.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Adjust doors and hardware, after installation, for proper operation.

3.2 FIELD QUALITY CONTROL

A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

END OF SECTION 083113

SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Insulated service doors.

B. Related Requirements:

   1. Section 055000 "Metal Fabrications" for miscellaneous steel supports, door-opening framing, corner guards, and bollards.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

   1. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
   2. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Special warranty.

B. Maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

   1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in ICC A117.1.

B. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:

1. Design Wind Load: As indicated on Drawings.
2. Testing: According to ASTM E330/E330M or DASMA 108 for garage doors and complying with acceptance criteria of DASMA 108.

C. Windborne-Debris Impact Resistance: Provide glazed and impact-protective overhead coiling doors that pass ASTM E1886 missile-impact and cyclic-pressure tests according to ASTM E1996 for Wind Zone 3 for basic protection.

1. Large-Missile Test: For overhead coiling doors located within 30 feet (9.1 m) of grade.

D. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 DOOR ASSEMBLY

A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

1. Manufacturers: The basis of design is the Thermiser Max Mode; ESD30 by Cornel Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Cookson Company.
b. Cornell.
c. Overhead Door Corporation.
d. Raynor.

B. Operation Cycles: Door components and operators capable of operating for not less than 50,000.

C. Curtain R-Value: R=8.0.

D. Door Curtain Material: Aluminum.

E. Door Curtain Slats: Flat profile slats of 2-5/8-inch center-to-center height.
   1. Insulated-Slat Interior Facing: Metal.

F. Bottom Bar: 6 x 2 x 3/8 tubular extrusion; fabricated from aluminum extrusions and finished to match door.

G. Curtain Jamb Guides: Aluminum with exposed finish matching curtain slats.

H. Hood: Match curtain material and finish Aluminum.

   1. Mounting: Face of wall.

I. Locking Devices: Equip door with locking device assembly.

   1. Locking Device Assembly: Cremone-type, both jamb sides locking bars, operable from inside and outside with cylinders.

J. Manual Door Operator: Chain-hoist operator.

K. Electric Door Operator:

   1. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
   2. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use.
   3. Motor Exposure: Interior.
   4. Motor Electrical Characteristics:

      a. Horsepower: 1/2 hp.
      b. Voltage: 115-V ac, single phase, 60 Hz.

   5. Emergency Manual Operation: Chain type.
   6. Obstruction-Detection Device: Automatic photoelectric sensor and electric sensor edge on bottom bar.
   7. Control Station(s): Where indicated on Drawings.
   8. Other Equipment: Portable radio-control system.

L. Curtain Accessories: Equip door with weather-seals push/pull handles and automatic-closing device.

M. Door Finish:

   1. Aluminum Finish: Anodized color as selected by Architect from full range of industry colors and color densities.
   2. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
   3. Factory Prime Finish: Manufacturer's standard color.
   4. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.3 MATERIALS, GENERAL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.4 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
   1. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84 or UL 723. Enclose insulation completely within slat faces.
   2. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch and minimum aluminum thickness of 0.032 inch.

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent over-travel of curtain.

2.5 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip the hood with intermediate support brackets as required to prevent sagging.

   1. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.
   2. Interior-Mounted Doors exposed to water from industrial processing: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.

2.6 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

   1. Lock Cylinders: As specified in Section 087100 "Door Hardware".
   2. Keys: Three for each cylinder.

B. Chain Lock Keeper: Suitable for padlock.

C. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.7 CURTAIN ACCESSORIES

A. Weather-seals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.

B. Astragal for Interior Doors: Equip each door bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.

C. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

D. Pull-Down Strap: Provide pull-down straps for doors more than 84 inches high.

2.8 COUNTERBALANCE MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.9 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated for each door assembly.

1. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.

2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.

D. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel. For fire-rated doors, activation delays closing.

1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.

a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained or constant pressure on close button.

2. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather-stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.

a. Self-Monitoring Type: Four-wire-configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.

3. Pneumatic Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device.

E. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."

1. Interior-Mounted Units exposed to water from industrial process and cleaning: Full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.

F. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lb.ft.

G. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

H. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

I. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with the accessibility standard.

J. Portable Radio-Control System: Consisting of two of the following per door operator:

1. Three-channel universal coaxial receiver to open, close, and stop door.

2. Portable control device to open and stop door may be momentary-contact type; control to close door shall be sustained- or constant-pressure type.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Power-Operated Doors: Install automatic garage doors openers according to UL 325.

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Test manual operation of closed door. Reset door-closing mechanism after successful test.

B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

C. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.3 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 083323

SECTION 083613 - SECTIONAL DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes manually or electrically operated sectional doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of sectional door and accessory.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Sectional doors shall comply with performance requirements specified without failure due to defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.

B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.

1. Design Wind Load: Uniform pressure (velocity pressure) of 20 lbf/sq. ft., acting inward and outward.
2. Testing: According to ASTM E330 or DASMA 108 for garage doors and complying with the acceptance criteria of DASMA 108.

C. Seismic Performance: Sectional doors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 DOOR ASSEMBLY

A. Aluminum Sectional Door: Sectional door formed with hinged sections and fabricated according to DASMA 102 unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Overhead Door Corporation.
b. Raynor Garage Doors.
c. Wayne-Dalton Corp.

B. Operation Cycles: Door components and operators capable of operating for not less than 50,000.

C. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E283.

D. R-Value: 15.0 deg F x h x sq. ft./Btu.

E. Steel Sections: Zinc-coated (galvanized) steel sheet with G60 zinc coating.

1. Section Thickness: 2 inches.
2. Exterior-Face Surface: Paneled.
3. Interior Facing Material: Zinc-coated (galvanized) steel sheet.

F. Aluminum Sections: Solid panels.

G. Track Configuration: Standard-lift & Low-headroom track.

H. Weather-seals: Fitted to bottom and top and around entire perimeter of door. Provide combination bottom weather-seal and sensor edge.

I. Windows: Approximately 24 by 7 inches, with curved corners, and spaced apart the approximate distance as indicated on Drawings; in one row(s) at height indicated on Drawings; installed with insulated glazing of clear float glass.

J. Locking Devices: Equip door with locking device assembly.

1. Locking Device Assembly: Cremone type, both jamb sides, locking bars, operable from inside with thumb-turn, outside with cylinder.

K. Electric Door Operator:

1. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
2. Operator Type: Jackshaft, side mounted.
3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet or lower.
4. Motor Exposure: Interior, clean, and dry.
5. Emergency Manual Operation: Chain type.
6. Obstruction-Detection Device: Automatic photoelectric sensor.
7. Control Station: Interior-side mounted.
8. Other Equipment: Portable, radio-control system.

L. Door Finish:

1. Aluminum Finish: Anodized color as selected by Engineer/Architect from manufacturer's full range.
2. Baked-Enamel or Powder-Coat Finish: Color and gloss as selected by Engineer/Architect from manufacturer's full range.
3. Factory Prime Finish: Manufacturer's standard color.
4. Finish of Interior Facing Material: Finish as selected by Engineer/Architect from manufacturer's full range.

2.3 STEEL DOOR SECTIONS

A. Exterior Section Faces and Frames: Zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet.

1. Roll horizontal meeting edges to a continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove weather-resistant seal, with a reinforcing flange return.
2. For insulated doors, provide sections with continuous thermal-break construction, separating the exterior and interior faces of door.

B. Section Ends and Intermediate Stiles: Enclose open ends of sections with channel end stiles formed from galvanized-steel sheet welded to door section. Provide intermediate stiles formed from galvanized-steel sheet, cut to door section profile, and welded in place. Space stiles not more than 48 inches apart.

C. Reinforce bottom section with a continuous channel or angle conforming to bottom-section profile and allowing installation of astragal.

D. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. Provide galvanized steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place. Ensure that reinforcement does not obstruct vision lites.

E. Provide reinforcement for hardware attachment.

F. Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard CFC-free insulation, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84. Enclose insulation completely within steel sections and the interior facing material, with no exposed insulation.

2.4 ALUMINUM DOOR SECTIONS

A. Sections: Extruded-aluminum stile and rail members with dimensions and profiles as indicated on Drawings; members joined by welding or with concealed, aluminum or nonmagnetic stainless-steel through bolts, full height of door section; and with meeting rails shaped to provide a weather-resistant seal.

1. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. Ensure that reinforcement does not obstruct vision lites.
2. Provide reinforcement for hardware attachment.

B. Solid Panels: Aluminum sheet, set in continuous vinyl channel retained with rigid, snap-in, extruded-vinyl moldings or with rubber or neoprene glazing gasket with aluminum stop.

C. Full-Vision Sections: Manufacturer's standard, tubular, aluminum-framed section fully glazed with 6-mm-thick, clear acrylic glazing set in vinyl, rubber, or neoprene glazing channel and with removable extruded-vinyl or aluminum stops.

2.5 TRACKS, SUPPORTS, AND ACCESSORIES

A. Tracks: Manufacturer's standard, galvanized-steel track system of configuration indicated, sized for door size and weight, designed for lift type indicated and clearances indicated on Drawings, Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides for required door type, size, weight, and loading.

1. Track Reinforcement and Supports: Galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches apart for door-drop safety device.

B. Weather-seals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and top of sectional door unless otherwise indicated.

C. Windows: Manufacturer's standard window units of type, size, and in arrangement indicated. Provide removable stops of same material as door-section frames.

2.6 HARDWARE

A. General: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.

B. Hinges: Heavy-duty, galvanized-steel hinges at each end stile and at each intermediate stile, according to manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails.

C. Rollers: Heavy-duty rollers with steel ball-bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Provide 3-inch-diameter roller tires for 3-inch-wide track and 2-inch-diameter roller tires for 2-inch-wide track.

D. Push/Pull Handles: Equip each push-up operated or emergency-operated door with galvanized-steel lifting handles on each side of door, finished to match door.

2.7 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on single-jamb side, operable from inside only.

B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded deadbolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

1. Lock Cylinders: Cylinders specified in Section 087100 "Door Hardware" and keyed to building keying system.
2. Keys: Three for each cylinder.

C. Chain Lock Keeper: Suitable for padlock.

D. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.8 COUNTERBALANCE MECHANISM

A. Torsion Spring: Counterbalance mechanism consisting of adjustable-tension torsion springs fabricated from steel-spring wire complying with ASTM A229/A229M, mounted on torsion shaft made of steel tube or solid steel. Provide springs designed for number of operation cycles indicated.

B. Cable Drums and Shaft for Doors: Cast-aluminum or gray-iron casting cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft.

C. Cables: Galvanized steel, multistrand, lifting cables.

D. Cable Safety Device: Include a spring-loaded steel or spring-loaded bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if either lifting cable breaks.

E. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.

F. Bumper: Provide spring bumper at each horizontal track to cushion door at end of opening operation.

2.9 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and "operation cycles" requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Chamberlain Group, Inc. (The).

2. Comply with NFPA 70.
3. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Door-Operator Type: Unit consisting of electric motor, gears, pulleys, belts, sprockets, chains, and controls needed to operate door and meet required usage classification.

D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated.

1. Electrical Characteristics:

    a. Phase: Single phase.
    b. Volts: 115 V.
    c. Hertz: 60.

2. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.

E. Obstruction Detection Device: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.

1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.

    a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained pressure on close button.

2. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom section. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.

    a. Self-Monitoring Type: Four-wire configured device designed to interface with door-operator control circuit to detect damage to or disconnection of sensor edge.

F. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure, push-button control labeled "Close."

1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
2. Exterior-Mounted Units: Full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.

G. Emergency Manual Operation: Equip electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.

H. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

I. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

J. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.

K. Portable Radio-Control System: Consisting of two of the following:

1. Three-channel universal coaxial receiver to open, close, and stop door.
2. Portable control devices to open and stop door may be momentary-contact type; control to close door shall be sustained- or constant-pressure type.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Tracks: Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.

C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

D. Power-Operated Doors: Install automatic garage doors openers according to UL 325.

E. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

F. Touch-up Painting: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A780/A780M.

3.2 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION 083613

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum-framed storefront systems.
2. Aluminum-framed entrance door systems.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at a location to be determined.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Show connection to and continuity with adjacent thermal, weather, air, & vapor barriers.
2. Include point-to-point wiring diagrams.

C. Samples: For each type of exposed finish required.

D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.

E. Delegated-Design Submittal: For aluminum-framed entrances and storefronts, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.

B. Product test reports.

C. Source quality-control reports.

D. Field quality-control reports.

E. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified according to ASTM E699 for testing indicated and accredited by the International Accreditation Service or the International Laboratory Accreditation Cooperation Mutual Recognition Arrangement as complying with ISO/IEC 17025 and acceptable to Owner and Engineer/Architect.

C. Product Options: Information on Drawings and Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Engineer/Architect, except with Engineer/Architect's approval. If changes are proposed, submit comprehensive explanatory data to Engineer/Architect for review.

1.7 WARRANTY

A. Special Warranty: Manufacturer or Installer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked-enamel, powder-coat, or organic finishes within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

C. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrances and storefronts.

B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.

D. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.

a. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.

3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:

a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch for spans greater than 11 feet 8-1/4 inches or 1/175 times span, for spans of less than 11 feet 8-1/4 inches.

E. Structural: Test according to ASTM E330/E330M as follows:

1. When tested at positive and negative wind-load design pressures, storefront assemblies, including entrance doors, do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, storefront assemblies, including entrance doors and anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Water Penetration under Static Pressure: Test according to ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.

G. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:

1. Thermal Transmittance (U-factor):

   a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.45 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
   b. Entrance Doors: U-factor of not more than 0.68 Btu/sq. ft. x h x deg F as determined according to NFRC 100.

2. Solar Heat-Gain Coefficient (SHGC):

   a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.35 as determined according to NFRC 200.
   b. Entrance Doors: SHGC of not more than 0.35 as determined according to NFRC 200.

3. Air Leakage:

   a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft. when tested according to ASTM E283.
   b. Entrance Doors: Air leakage of not more than 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.

4. Condensation Resistance Factor (CRF):

   a. Fixed Glazing and Framing Areas: CRF for the system of not less than 55 as determined according to AAMA 1503.
   b. Entrance Doors: CRF of not less than 63 as determined according to AAMA 1503.

H. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 STOREFRONT SYSTEMS

A. Manufacturers: Subject to compliance with requirements, and contingent upon the use of one manufacturer for aluminum framed entrances and storefronts and aluminum windows, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. EFCO Corporation.
2. Kawneer North America, an Arconic company.

B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Exterior Framing Construction: Thermally broken.
2. Interior Vestibule Framing Construction: Nonthermal.
3. Glazing System: Retained mechanically with gaskets on four sides.
4. Finish: Baked-enamel or powder-coat finish.
5. Fabrication Method: Field-fabricated stick system.
6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
7. Steel Reinforcement: As required by manufacturer.

C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.3 ENTRANCE DOOR SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. EFCO Corporation.
2. Kawneer North America, an Arconic company.

B. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.

1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

    a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.

2. Door Design: Wide stile; 5-inch nominal width.
3. Glazing Stops & Gaskets: Beveled, snap-on, extruded-aluminum stops & preformed gaskets.

a. Provide nonremovable glazing stops on outside of door.

2.4 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."

B. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door, to comply with requirements in this Section.

1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
3. Opening-Force Requirements:

    a. Egress Doors: Not more than 15 lbf to release the latch and not more than 30 lbf to set the door in motion and not more than 15 lbf to open the door to its minimum required width.
    b. Accessible Interior Doors: Not more than 5 lbf to fully open door.

C. Designations: Requirements for design, grade, function, finish, quantity, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified using entrance door hardware designations as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

D. Butt Hinges: BHMA A156.1, Grade 1, radius corner.

1. Nonremovable Pins: Provide setscrew in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while entrance door is closed.
2. Exterior Hinges: Stainless steel, with stainless-steel pin.
3. Quantities:

    a. For doors up to 87 inches high, provide three hinges per leaf.
    b. For doors more than 87 and up to 120 inches high, provide four hinges per leaf.

E. Continuous-Gear Hinges: BHMA A156.26.

F. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.

G. Manual Flush Bolts: BHMA A156.16, Grade 1.

H. Automatic and Self-Latching Flush Bolts: BHMA A156.3, Grade 1.

I. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.

J. Cylinders:

1. As specified in Section 087100 "Door Hardware."
2. BHMA A156.5, Grade 1.

    a. Keying: Master key system. Permanently inscribe each key with a visual key control number and include notation "DO NOT DUPLICATE" to be furnished by Owner.

K. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.

L. Operating Trim: BHMA A156.6.

M. Removable Mullions: BHMA A156.3 extruded aluminum.

1. When used with panic exit devices, provide keyed removable mullions listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305. Use only mullions that have been tested with exit devices to be used.

N. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to comply with field conditions and requirements for opening force.

O. Concealed Overhead Holders and Stops: BHMA A156.8, Grade 1.

P. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.

Q. Weather Stripping: Manufacturer's standard replaceable components.

1. Compression Type: Made of ASTM D2000 molded neoprene or ASTM D2287 molded PVC.
2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

R. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

S. Thresholds: BHMA A156.21 raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch.

T. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

2.5 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: As recommended by manufacturer.

2.6 MATERIALS

A. Sheet and Plate: ASTM B209.

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.

C. Extruded Structural Pipe and Tubes: ASTM B429/B429M.

D. Structural Profiles: ASTM B308/B308M.

E. Steel Reinforcement:

1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

F. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

2.7 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

G. Entrance Door Hardware Installation: Factory install entrance door hardware to greatest extent possible. Cut, drill, & tap for factory-installed entrance door hardware before applying finishes.

H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.8 ALUMINUM FINISHES

A. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Color and Gloss: As selected by Engineer/Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Seal perimeter and other joints watertight unless otherwise indicated.

G. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

H. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.

I. Install joint filler behind sealant as recommended by sealant manufacturer.

J. Install components plumb and true in alignment with established lines and grades.

3.2 INSTALLATION OF GLAZING

A. Install glazing as specified in Section 088000 "Glazing."

3.3 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE DOORS

A. Install entrance doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.4 FIELD QUALITY CONTROL

A. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and storefronts mockups.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Engineer/Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

    a. Perform a minimum of two tests in areas as directed by Engineer/Architect.

2. Air Leakage: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..

    a. Perform a minimum of two tests in areas as directed by Engineer/Architect.

3. Water Penetration: ASTM E1105 at a minimum uniform static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and shall not evidence water penetration.

B. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 084113

SECTION 085113 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes aluminum windows for exterior locations.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at a location to be determined.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

C. Samples: For each exposed product and for each color specified.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranties.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. Window: 10 years from date of Substantial Completion.
b. Glazing Units: 10 years from date of Substantial Completion.
c. Aluminum Finish: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 WINDOW PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Window Certification: AAMA certified with label attached to each window.

B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:

1. Minimum Performance Class: CW.
2. Minimum Performance Grade: 30.

C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.30 Btu/sq. ft. x h x deg F.

D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.40.

E. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 62.

F. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F ambient; 180 deg F material surfaces.

2.2 ALUMINUM WINDOWS

A. Manufacturers: Subject to compliance with requirements, and contingent upon the use of one manufacturer for aluminum windows and aluminum framed entrances and storefronts, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. EFCO Corporation.
2. Kawneer North America, an Arconic company.

B. Types: As indicated on Drawings.

C. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.

1. Thermally Improved Construction: Fabricate frames, sashes, and muntins with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.

D. Glass: Clear annealed glass, ASTM C1036, Type 1, Class 1, q3.

1. Kind: Fully tempered where indicated on Drawings.

E. Insulating-Glass Units: ASTM E2190.

1. Glass: ASTM C1036, Type 1, Class 1, q3.

a. Tint: Clear.
b. Kind: Fully tempered where indicated on Drawings.

2. Lites: Two.
3. Filling: Fill space between glass lites with argon.
4. Low-E Coating: Sputtered on second or third surface.

F. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

G. Hardware, General: Provide manufacturer's standard corrosion-resistant hardware sized to accommodate sash weight and dimensions.

1. Exposed Hardware Color and Finish: As selected by Engineer/Architect from manufacturer's full range.

H. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.

I. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.3 ACCESSORIES

A. Subsills: Thermally broken, extruded-aluminum subsills in configurations indicated on Drawings.

B. Column Covers: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.

C. Interior Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.

D. Panning Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.

E. Receptor System: Two-piece, snap-together, thermally broken, extruded-aluminum receptor system that anchors windows in place.

2.4 FABRICATION

A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

B. Glaze aluminum windows in the factory.

C. Weather strip each operable sash to provide weathertight installation.

D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.

E. Provide water-shed members above side-hinged sashes and similar lines of natural water penetration.

F. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.

G. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.

2.5 ALUMINUM FINISHES

A. High-Performance Organic Finish (Two-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Engineer/Architect from full range of industry colors and color densities.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

E. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

F. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

G. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 085113

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanical door hardware for the following:

a. Swinging doors.
b. Folding doors.

2. Cylinders for door hardware specified in other Sections.
3. Electrified door hardware.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at a location to be determined.

B. Keying Conference: Conduct conference at a location to be determined.

1.3 SUBMITTALS

A. General:
1. Submit in accordance with Conditions of Contract and Division 01 requirements.

2. Highlight, encircle, or otherwise specifically identity on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the work.

3. Prior to forwarding submittal, comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, “Execution” article, herein.

B. Action Submittals:
1. Product Data: Technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.

2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:

a. Wiring Diagrams: For power, signal, and control wiring and including:
1) Details of interface of electrified door hardware and building safety and security systems.
2) Schematic diagram of systems that interface with electrified door hardware.

3) Point-to-point wiring.
4) Risers.

3. Samples for Verification: If requested by Engineer/Architect, submit production sample or sample installations of each type of exposed hardware unit in finish indicated, and tagged with full description for coordination with schedule.

   a. Samples will be returned to supplier. Units that are acceptable to Engineer/Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

4. Door Hardware Schedule: Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:

   a. Door Index; include door number, heading number, and Engineers/Architects hardware set number.
   b. Opening Lock Function Spreadsheet: List locking device and function for each opening.
   c. Quantity, type, style, function, size, and finish of each hardware item.
   d. Name and manufacturer of each item.
   e. Fastenings and other pertinent information.
   f. Location of each hardware set cross-referenced to indications on Drawings.
   g. Explanation of all abbreviations, symbols, and codes contained in schedule.
   h. Mounting locations for hardware.
   i. Door and frame sizes and materials.
   j. Name and phone number for local manufacturer's representative for each product.
   k. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and access control components). Operational description should include operational descriptions for: egress, ingress (access), and fire/smoke alarm connections.
      1) Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work that is critical in Project construction schedule.

5. Key Schedule:

   a. After Keying Conference, provide keying schedule listing levels of keying as well as explanation of key system's function, key symbols used and door numbers controlled.
   b. Use ANSI/BHMA A156.28 “Recommended Practices for Keying Systems” as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
   c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
   d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.

e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion.
   1) Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.

6. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

C. Informational Submittals:

1. Qualification Data: For Supplier, Installer and Architectural Hardware Consultant.
2. Product data for electrified door hardware:
   a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
3. Certificates of Compliance:
   a. UL listings for fire-rated hardware and installation instructions if requested by Engineer/Architect or Authority Having Jurisdiction.
   b. Installer Training Meeting Certification: Letter of compliance, signed by Contractor, attesting to completion of installer training meeting specified in "QUALITY ASSURANCE" article, herein.
   c. Electrified Hardware Coordination Conference Certification: Letter of compliance, signed by Contractor, attesting to completion of electrified hardware coordination conference, specified in "QUALITY ASSURANCE" article, herein.
4. Warranty: Special warranty specified in this Section.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:

   a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
   b. Catalog pages for each product.
   c. Factory order acknowledgement numbers (for warranty and service)
   d. Name, address, and phone number of local representative for each manufacturer.
   e. Parts list for each product.
   f. Final approved hardware schedule, edited to reflect conditions as-installed.
   g. Final keying schedule
   h. Copies of floor plans with keying nomenclature
   i. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
   j. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

1.4 QUALITY ASSURANCE

A. Supplier Qualifications and Responsibilities: Recognized Architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) available to Owner, Engineer/Architect, and Contractor, at reasonable times during the Work for consultation.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
4. Coordination Responsibility: Assist in coordinating installation of electronic security hardware with Engineer/Architect and electrical engineers and provide installation and technical data to Engineer/Architect and other related subcontractors.
    a. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.

B. Architectural Hardware Consultant Qualifications: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:

1. For door hardware, DHI-certified, Architectural Hardware Consultant (AHC).
2. Can provide installation and technical data to Engineer/Architect and other related subcontractors.
3. Can inspect and verify components are in working order upon completion of installation.
4. Capable of producing wiring diagrams.
5. Capable of coordinating installation of electrified hardware with Engineer/Architect and electrical engineers.

C. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

D. Fire-Rated Door Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

E. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

F. Accessibility Requirements: For door hardware on doors in an accessible route, comply with governing accessibility regulations cited in “REFERENCES” article, herein.

G. Keying Conference

1. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:

    a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
    b. Preliminary key system schematic diagram.
    c. Requirements for key control system.

d. Requirements for access control.
e. Address for delivery of keys.

H. Pre-installation Conference

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Inspect and discuss preparatory work performed by other trades.
3. Inspect and discuss electrical roughing-in for electrified door hardware.
4. Review sequence of operation for each type of electrified door hardware.
5. Review required testing, inspecting, and certifying procedures.

I. Coordination Conferences:

1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.
2. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:

a. Electromagnetic and Delayed-Egress Locks: Five years from date of Substantial Completion.
b. Exit Devices: Two years from date of Substantial Completion.
c. Manual Closers: 10 years from date of Substantial Completion.
d. Concealed Floor Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

B. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that complies with requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. at the tested pressure differential of 0.3-inch wg of water.

C. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

E. Accessibility Requirements: For door hardware on doors in an accessible route, comply with ICC A117.1.

2.2 HINGES

A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Allegion plc.
b. Bommer Industries, Inc.
c. McKinney Products Company; an ASSA ABLOY Group company.
d. Stanley Commercial Hardware; a division of Stanley Security Solutions.

2.3 CONTINUOUS HINGES

A. Continuous Hinges: BHMA A156.26; minimum 0.120-inch-thick, hinge leaves with minimum overall width of 4 inches; fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.

B. Pin-and-Barrel-Type Hinges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Allegion plc.
b. McKinney Products Company; an ASSA ABLOY Group company.
c. Stanley Commercial Hardware; a division of Stanley Security Solutions.

C. Continuous, Gear-Type Hinges: Extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Allegion plc.
b. Bommer Industries, Inc.

c. McKinney Products Company; an ASSA ABLOY Group company.
d. Stanley Commercial Hardware; a division of Stanley Security Solutions.
e. Zero International, Inc.

2.4 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:

1. Bored Locks: Minimum 1/2-inch latchbolt throw.
2. Mortise Locks: Minimum 3/4-inch latchbolt throw.
3. Deadbolts: Minimum 1-inch bolt throw.

C. Lock Backset: 2-3/4 inches unless otherwise indicated.

D. Lock Trim:

1. Description: K Series.
2. Levers: Cast.

a. Dane.

3. Escutcheons (Roses): Cast.
4. Dummy Trim: Match lever lock trim and escutcheons.

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.

F. Bored Locks: BHMA A156.2; Grade 1; Series 4000.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Allegion plc.
b. Arrow USA; an ASSA ABLOY Group company.
c. Best Access Systems; Stanley Security Solutions, Inc.
d. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
e. SARGENT Manufacturing Company; ASSA ABLOY.
f. Stanley Commercial Hardware; a division of Stanley Security Solutions.
g. Yale Security Inc; an ASSA ABLOY Group company.

G. Mortise Locks: BHMA A156.13; Security Grade 1; stamped steel case with steel or brass parts; Series 1000.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Allegion plc.
b. Best Access Systems; Stanley Security Solutions, Inc.
c. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
d. SARGENT Manufacturing Company; ASSA ABLOY.
e. Stanley Commercial Hardware; a division of Stanley Security Solutions.
f. Yale Security Inc; an ASSA ABLOY Group company.

2.5 AUXILIARY LOCKS

A. Bored Auxiliary Locks: BHMA A156.36: Grade 1; with strike that suits frame.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Allegion plc.
b. Best Access Systems; Stanley Security Solutions, Inc.
c. SARGENT Manufacturing Company; ASSA ABLOY.
d. Stanley Commercial Hardware; a division of Stanley Security Solutions.
e. Yale Security Inc; an ASSA ABLOY Group company.

B. Mortise Auxiliary Locks: BHMA A156.36; Grade 1; with strike that suits frame.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Allegion plc.
b. Best Access Systems; Stanley Security Solutions, Inc.
c. SARGENT Manufacturing Company; ASSA ABLOY.
d. Stanley Commercial Hardware; a division of Stanley Security Solutions.
e. Yale Security Inc; an ASSA ABLOY Group company.

C. Narrow Stile Auxiliary Locks: BHMA A156.36; Grade 1; with strike that suits frame.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Accurate Lock & Hardware Co.
b. Adams Rite Manufacturing Co; an ASSA ABLOY Group company.
c. Kaba Ilco Corp.

D. Push-Button Combination Locks: BHMA A156.36; cylindrical; Grade 1; lock opens by entering a one- to five-digit code by pushing correct buttons in correct sequence; automatically relocks when door is closed; with strike that suits frame.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Kaba Ilco Corp.

2.6 ELECTRIC STRIKES

A. Electric Strikes: BHMA A156.31; Grade 1; with faceplate to suit lock and frame.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Allegion plc.
b. Securitron Magnalock Corporation; an ASSA ABLOY Group company.
c. Stanley Commercial Hardware; a division of Stanley Security Solutions.

2.7 ELECTROMAGNETIC LOCKS

A. Electromagnetic Locks: BHMA A156.23; electrically powered; with electromagnet attached to frame and armature plate attached to door; full-exterior or full-interior type, as required by application indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Allegion plc.
b. Door Controls International, Inc.
c. Securitron Magnalock Corporation; an ASSA ABLOY Group company.
d. Security Door Controls.

2.8 ELECTROMECHANICAL LOCKS

A. Electromechanical Locks: BHMA A156.25; Grade 1; motor or solenoid driven; with strike that suits frame.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Best Access Systems; Stanley Security Solutions, Inc.
c. SARGENT Manufacturing Company; ASSA ABLOY.
d. Security Door Controls.
e. Stanley Commercial Hardware; a division of Stanley Security Solutions.
f. Yale Security Inc; an ASSA ABLOY Group company.

2. Type: Mortise latchbolt.

2.9 SELF-CONTAINED ELECTRONIC LOCKS

A. Self-Contained Electronic Locks: BHMA A156.25, mortise; with internal, battery-powered, self-contained electronic locks; consisting of complete lockset, motor-driven lock mechanism, and actuating device; enclosed in zinc-dichromate-plated, wrought-steel case, and strike that suits frame. Provide key override, low-battery detection and warning, LED status indicators, and ability to program at the lock.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Best Access Systems; Stanley Security Solutions, Inc.
c. SARGENT Manufacturing Company; ASSA ABLOY.
d. Yale Security Inc; an ASSA ABLOY Group company.

2.10 EXIT LOCKS AND EXIT ALARMS

A. Exit Locks and Alarms: BHMA A156.29, Grade 1.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Arrow USA; an ASSA ABLOY Group company.
b. Detex Corporation.
c. Precision Hardware, Inc.; a Stanley company.
d. SARGENT Manufacturing Company; ASSA ABLOY.

2.11 SURFACE BOLTS

A. Surface Bolts: BHMA A156.16.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Burns Manufacturing Incorporated.
c. Door Controls International, Inc.
d. Trimco.

2.12 MANUAL FLUSH BOLTS

A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch throw; designed for mortising into door edge.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Adams Rite Manufacturing Co; an ASSA ABLOY Group company.

b. Allegion plc.
c. Burns Manufacturing Incorporated.
d. Door Controls International, Inc.

2.13 EXIT DEVICES AND AUXILIARY ITEMS

A. Exit Devices and Auxiliary Items: BHMA A156.3.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Allegion plc.
b. Arrow USA; an ASSA ABLOY Group company.
c. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
d. Door Controls International, Inc.
e. SARGENT Manufacturing Company; ASSA ABLOY.
f. Stanley Commercial Hardware; a division of Stanley Security Solutions.
g. Yale Security Inc; an ASSA ABLOY Group company.

2.14 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Allegion plc.
b. Arrow USA; an ASSA ABLOY Group company.
c. Best Access Systems; Stanley Security Solutions, Inc.
d. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
e. SARGENT Manufacturing Company; ASSA ABLOY.
f. Stanley Commercial Hardware; a division of Stanley Security Solutions.
g. Yale Security Inc; an ASSA ABLOY Group company.

B. Standard Lock Cylinders: BHMA A156.5; Grade 1 permanent cores; face finished to match lockset.

1. Core Type: Removable.

C. High-Security Lock Cylinders: BHMA A156.30; Grade 1 permanent cores that are removable; face finished to match lockset.

1. Type: M, mechanical.

D. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.

E. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.15 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock. Incorporate decisions made in keying conference.

1. No Master Key System: Only change keys operate cylinders.

a. Provide three cylinder change keys.

2. Master Key System: Change keys and a master key operate cylinders.

a. Provide three cylinder change keys and five master keys.

3. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders.

a. Provide three cylinder change keys and five each of master and grand master keys.

4. Great-Grand Master Key System: Change keys, a master key, a grand master key, and a great-grand master key operate cylinders.

a. Provide three cylinder change keys and five each of master, grand master, and great-grand master keys.

5. Existing System:

a. Master key or grand master key locks to Owner's existing system.

6. Keyed Alike: Key all cylinders to same change key.

B. Keys: Nickel silver.

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

a. Notation: "DO NOT DUPLICATE."

2.16 KEY CONTROL SYSTEM

A. Key Control Cabinet: BHMA A156.28; metal cabinet with baked-enamel finish; containing key-holding hooks, labels, two sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150 percent of the number of locks.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Key Boxes and Cabinets.
b. GE Security, Inc.
c. HPC, Inc.
d. Lund Equipment Co., Inc.
e. MMF Industries.
f. TelKee; Oasis International.

2. Multiple-Drawer Cabinet: Grade 1 cabinet with drawers equipped with key-holding panels and key envelope storage, and progressive-type ball-bearing suspension slides. Include single cylinder lock to lock all drawers.
3. Wall-Mounted Cabinet: Grade 1 cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock.
4. Portable Cabinet: Grade 1 tray for mounting in file cabinet, equipped with key-holding panels, envelopes, and cross-index system.

2.17 OPERATING TRIM

A. Operating Trim: BHMA A156.6; aluminum unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Allegion plc.
b. Burns Manufacturing Incorporated.
c. Rockwood Manufacturing Company; an ASSA ABLOY Group company.

2.18 ACCESSORIES FOR PAIRS OF DOORS

A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release; and with internal override.

B. Carry-Open Bars: BHMA A156.3; prevent the inactive leaf from opening before the active leaf; provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.

C. Astragals: BHMA A156.22.

2.19 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Arrow USA; an ASSA ABLOY Group company.
c. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
d. Hager Companies.
e. Norton Door Controls; an ASSA ABLOY Group company.
f. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
g. SARGENT Manufacturing Company; ASSA ABLOY.
h. Stanley Commercial Hardware; a division of Stanley Security Solutions.
i. Yale Security Inc; an ASSA ABLOY Group company.

2.20 CONCEALED CLOSERS

A. Concealed Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. DORMA USA, Inc.
c. Norton Door Controls; an ASSA ABLOY Group company.
d. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
e. SARGENT Manufacturing Company; ASSA ABLOY.

2.21 CLOSER HOLDER RELEASE DEVICES

A. Closer Holder Release Devices: BHMA A156.15; Grade 1; closer connected with separate or integral releasing and fire- or smoke-detecting devices. Door shall become self-closing on interruption of signal to release device. Automatic release is activated by smoke detection system or loss of power.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Corbin Russwin, Inc.; an ASSA ABLOY Group company.
c. DORMA USA, Inc.
d. Norton Door Controls; an ASSA ABLOY Group company.
e. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
f. SARGENT Manufacturing Company; ASSA ABLOY.
g. Stanley Commercial Hardware; a division of Stanley Security Solutions.

2.22 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: BHMA A156.16.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Architectural Builders Hardware Mfg., Inc.
c. Baldwin Hardware Corporation.
d. Burns Manufacturing Incorporated.
e. Door Controls International, Inc.
f. Hager Companies.
g. Rockwood Manufacturing Company; an ASSA ABLOY Group company.

2.23 ELECTROMAGNETIC STOPS AND HOLDERS

A. Electromagnetic Door Holders: BHMA A156.15, Grade 1; wall-mounted electromagnetic single unit with strike plate attached to swinging door; coordinated with fire detectors and interface with fire-alarm system for labeled fire-rated door assemblies.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Architectural Builders Hardware Mfg., Inc.
c. DORMA USA, Inc.
d. Hager Companies.
e. SARGENT Manufacturing Company; ASSA ABLOY.

2.24 OVERHEAD STOPS AND HOLDERS

A. Overhead Stops and Holders: BHMA A156.8.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Architectural Builders Hardware Mfg., Inc.
c. DORMA USA, Inc.
d. Hager Companies.
e. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
f. SARGENT Manufacturing Company; ASSA ABLOY.

2.25 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. M-D Building Products, Inc.
c. National Guard Products, Inc.
d. Pemko Manufacturing Co.
e. Reese Enterprises, Inc.
f. Sealeze.

g. Zero International, Inc.

B. Maximum Air Leakage: When tested according to ASTM E283 with tested pressure differential of 0.3-inch wg, as follows:

1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. of door opening.
2. Gasketing on Single Doors: 0.3 cfm/sq. ft. of door opening.
3. Gasketing on Double Doors: 0.50 cfm per foot of door opening.

2.26 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hager Companies.
b. M-D Building Products, Inc.
c. National Guard Products, Inc.
d. Pemko Manufacturing Co.
e. Reese Enterprises, Inc.
f. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
g. Sealeze.
h. Zero International, Inc.

2.27 SLIDING DOOR HARDWARE

A. Sliding Door Hardware: BHMA A156.14; consisting of complete sets including rails, hangers, supports, bumpers, floor guides, and accessories indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Arthur Cox & Sons, Inc.
b. Hager Companies.
c. Hettich America L.P.
d. Johnson, L. E., Products, Inc.
e. K.N. Crowder Mfg. Inc.
f. PC Henderson Inc.
g. Stanley Commercial Hardware; a division of Stanley Security Solutions.

2.28 FOLDING DOOR HARDWARE

A. General: BHMA A156.14; complete sets including overhead rails, hangers, supports, bumpers, floor guides, and accessories indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Arthur Cox & Sons, Inc.

b. Johnson, L. E., Products, Inc.
c. PC Henderson Inc.
d. Stanley Commercial Hardware; a division of Stanley Security Solutions.

2.29 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch-thick aluminum; with manufacturer's standard machine or self-tapping screw fasteners.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Burns Manufacturing Incorporated.
c. Hager Companies.
d. Inpro Corporation.
e. Pawling Corporation.
f. Rockwood Manufacturing Company; an ASSA ABLOY Group company.

2.30 AUXILIARY DOOR HARDWARE

A. Auxiliary Hardware: BHMA A156.16.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Baldwin Hardware Corporation.
c. Hager Companies.
d. Rockwood Manufacturing Company; an ASSA ABLOY Group company.

2.31 AUXILIARY ELECTRIFIED DOOR HARDWARE

A. Auxiliary Electrified Door Hardware:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allegion plc.
b. Door Controls International, Inc.
c. DORMA USA, Inc.
d. DynaLock Corp.
e. GE Security, Inc.
f. Precision Hardware, Inc.; a Stanley company.
g. Rutherford Controls Int'l. Corp.
h. SARGENT Manufacturing Company; ASSA ABLOY.
i. Securitron Magnalock Corporation; an ASSA ABLOY Group company.
j. Security Door Controls.

2.32 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule, but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches of door height greater than 90 inches.

E. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as indicated in keying schedule or directed by Owner.

F. Key Control Cabinet: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

G. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings. Verify location with Engineer/Architect.

1. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.

H. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

I. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

J. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

1. Do not notch perimeter gasketing to install other surface-applied hardware.

K. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

L. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.2 ADJUSTING

A. Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.3 DOOR HARDWARE SCHEDULE

A. The following schedule is furnished for whatever assistance it may afford the Contractor; do not consider it as entirely inclusive. Should any particular door or item be omitted in any scheduled hardware heading, provide door or item with hardware same as required for similar purposes.

Hardware supplier is responsible for handing and sizing all products as listed in the hardware heading. Quantities listed are for each pair of doors, or for each single door.

B. Manufacturer's Abbreviations depicting basis of design for these items:

1. SCH – Schlage
2. VON – Von Duprin
3. LCN – Allegion LCN
4. NGP - NGP
5. IVE – Ives
6. FAL – Falcon
7. ZER – Zero
8. GLY – Glynnis-Johnson

HARDWARE SETS

QTY	ITEM	MODEL NUMBER	FINISH	MFR
SET # 1	***- 201, 202, 501, 553, 554, 555***			
2	CONT. HINGE	112HD	628	IVE
1	STOREROOM LOCK	T581H7 DANE	626	FAL
2	MORTISE CYLINDER	C987-7CCA 5622-IC	626	FAL
2	SFIC CORE	C607	626	FAL
2	OH STOP	100S	630	GLY
2	SURFACE CLOSER	1450 EDA	695	LCN
2	PA MOUNTING PLATE	1450-18PA	689	LCN
2	BLADE STOP SPACER	1450-61	689	LCN
2	MANUAL FLUSH BOLTS	FB458	626	IVE
1	DUST PROOF STRIKE	DP2	626	IVE
1	LOCK GUARD	LG14	630	IVE
2	DOOR SWEEP	39A	A	ZER
1	THRESHOLD	626	A	ZER
1	GASKETING	488SBK PSA	BK	ZER
ACCESS	**CONTROL HARDWARE**	**INCL READER & ELEC STRIKE TO BE BY OTHERS**		
SET # 2	***- 401A, 402A,540A, 550A, 559, 706A, 707, 716, 951***			
1	CONT. HINGE	112HD	628	IVE
1	STOREROOM LOCK	T581H7 DANE	626	FAL
1	MORTISE CYLINDER	C987-7CCA 5622-IC	626	FAL
1	OH STOP	100S	630	FAL
1	SFIC CORE	C607	626	FAL
1	SURFACE CLOSER	1450 EDA STD	689	LCN
2	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	GASKETING	488SBK PSA	BK	ZER
1	LOCK GUARD	LG14	630	IVE
1	MOUNTING PLATE	1450-18	689	LCN
1	THRESHOLD	626	A	ZER
ACCESS	**CONTROL HARDWARE**	**INCLUDING CARD READER & ELEC STRIKE TO BE BY OTHERS**		
SET # 3	***- 203, 546***			
1	HINGE	5BB1 4.5 X 4.5	652	IVE
1	STOREROOM LOCK	T581H7 DANE	626	FAL
1	SFIC CORE	C607	626	FAL
1	OH STOP	100S	630	GLY
1	MORTISE CYLINDER	C987-7CCA-5622-IC	626	FAL
1	SURFACE CLOSER	1450 EDA STD	689	LCN
1	LOCK GUARD	LG14	630	IVE

QTY	ITEM	MODEL NUMBER	FINISH	MR
1	MOUNTING PLATE	1450-18	689	LCN
2	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	GASKETING	488SBK PSA	BK	ZER
1	THRESHOLD	655A	A	ZER
		INCLUDING CARD READER & ELEC STRIKE TO BE BY OTHERS		
ACCESS	**CONTROL HARDWARE**			
SET # 4	***- 544, 561, 562, 563, 711, 712, 713, 714, 720***			
3	HINGE	5BB1 4.5 X 4.5	652	IVE
1	CLASSROOM LOCK	T561H7 DANE	626	FAL
1	SFIC CORE	C607	626	FAL
1	MORTISE CYLINDER	C987-7CCA-5622-IC	626	FAL
1	SURFACE CLOSER	1450 REG ARM MOUNT	695	LCN
2	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
1	WALL STOP	WS406/407CVX	630	IVE
3	SILENCER	SR64	GRY	IVE
SET # 5	***552***			
6	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
2	MANUAL FLUSH BOLT	FB458	626	IVE
1	DUST PROOF STRIKE	DP2	626	IVE
1	MORTISE CYLINDER	C987-7CCA-5622-IC	626	FAL
1	CLASSROOM LOCK	T561H7 DANE	626	FAL
1	SFIC CORE	C607	626	FAL
2	SURFACE CLOSER	1450 EDA STD	689	LCN
2	OH STOP	90S	652	GLY
4	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
2	SILENCER	SR64	GRY	IVE
SET # 6	***- 402C, 540C, 550C, 706B, 715, 717***			
3	HINGE	5BB1 4.5 X 4.5	652	IVE
1	PASSAGE SET	T101 DANE	626	FAL
1	MORTISE CYLINDER	C987-7CCA-5622-IC	626	FAL
1	SURFACE CLOSER	1450 EDA STD	689	LCN
2	OH STOP	905	652	GLY
1	SFIC CORE	C607	626	FAL
2	KICK PLATE	8400 10”x1” LDW B-CS	630	IVE
SET # 7	718, 719			
3	HINGE	5BB1 4.5 X 4.5	652	IVE
1	CLASSROOM DEAD LOCK	L463HD	626	SCH
1	MORTISE CYLINDER	C987-7CCA-5622-IC	626	FAL
1	SFIC CORE	C607	626	FAL
1	DOOR PULL, 1" ROUND	8103EZHD 10" O	630-316	IVE

QTY	ITEM	MODEL NUMBER	FINISH	MR
1	PUSH PLATE	8200 3” X 12”	630	IVE
1	SURFACE CLOSER	1450 REG ARM MOUNT	695	LCN
2	KICK PLATE	8400 10" X 1 1/2" LDW B-CS	630	IVE
3	SILENCER	SR64	GRY	IVE
SET # 8	***- 710***			
2	CONT. HINGE	112HD	628	IVE
1	STOREROOM LOCK	T581H7 DANE	626	FAL
1	MORTISE CYLINDER	C987-7CCA 5622-IC	626	FAL
1	SFIC CORE	C607	626	FAL
1	LOCK GUARD	LG14	630	IVE
2	OH STOP	100S	630	GLY
2	SURFACE CLOSER	1450 EDA	695	LCN
2	PA MOUNTING PLATE	1450-18PA	689	LCN
2	BLADE STOP SPACER	1450-61	689	LCN
2	DOOR SWEEP	39A	A	ZER
2	MANUAL FLUSH BOLT	FB458	626	IVE
1	THRESHOLD	626	A	ZER
SET # 9	***- 403 552***			
3	HINGE	5BB1 4.5 X 4.5	652	IVE
1	PASSAGE SET	T101 DANE	626	IVE
1	SURFACE CLOSER	1450 EDA STD	689	LCN
1	OH STOP	905	652	GLY
1	SFIC CORE	C607	626	FAL
2	KICKPLATE	8400 10” X 1 ½” LDW B-CS	630	IVE
1	GASKETING	488 SBK PSA	BK	ZER
1	DOOR SWEEP	39A	A	ZER
SET # 10	***- 402C***			
3	HINGE	5BB1 4.5 X 4.5	652	IVE
1	PASSAGE SET	T101 DANE	626	FAL
1	SURFACE CLOSER	140 EDA STD	689	LCN
1	WALL STOP	WS406/407CVX	630	IVE
1	SFIC CORE	C607	626	FAL
3	SILENCER	SR64	GRY	IVE
SET # 11	***-DOOR 545***			
3	HINGE	5BB1 4.5 X 4.5	652	IVE
1	CLASSROOM LOCK	T561H7 DANE	626	FAL
1	SFIC CORE	C607	626	IVE
1	MORTISE CYLINDER	C987-7CCA-5622-IC	626	FAL
1	SURFACE CLOSER	1450 EDA STD	689	LCN
2	KICK PLATE	8400 10”x1” LDW B-CS	630	IVE
1	WALL STOP	WS406/407CVX	630	IVE

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes but is not necessarily limited to:

1. Glass for windows, doors and sidelights.
2. Glazing sealants and accessories.
3. Fire Protection Rated Glazing

1.2 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

D. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Preconstruction adhesion and compatibility test report.

1.5 QUALITY ASSURANCE

A. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

1.7 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Fire-Rated Glass: Manufacturer agrees to replace fired-rated glass units that deteriorate within specified warranty period. Deterioration of fired-rated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning fired-rated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced fired-rated glass standard.

1. Warranty Period: 10 years from date of Substantial Completion.

C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Cardinal Glass Industries.
2. Guardian Glass; SunGuard.
3. Pilkington North America.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.

B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the International Building Code and ASTM E1300.

1. Design Wind Pressures: As indicated on Drawings.
2. Design Snow Loads: As indicated on Drawings.
3. Thickness of Patterned Glass: Base design of patterned glass on thickness at thinnest part of the glass.
4. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

C. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
2. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
2. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
3. IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."
4. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.

E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.

B. Tinted Annealed Float Glass: ASTM C1036, Type I, Class 2 (tinted), Quality-Q3.

C. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

D. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

E. Pyrolytic-Coated, Low-Maintenance Glass: Clear float glass with a coating on first surface having both photocatalytic and hydrophilic properties that act to loosen dirt and to cause water to sheet evenly over the glass instead of beading.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Pilkington North America.
b. Saint-Gobain Glass Exprover NA.

F. Silicone-Coated Spandrel Glass: ASTM C1048, Type I, Condition C, Quality-Q3.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. ICD High Performance Coatings.

2.5 FIRE PROTECTION RATED GLASS

A. Fire Protection Rated Glass Basis of Design: SuperClear 45-HS as manufactured by Safety and Fire Technology Inc., phone (888) 653-3333, web site http://www.safti.com . Use materials that have a proven record of no tendency to lose physical and mechanical properties after fabrication and installation.
1. Fire-rated glass ceramic clear and wireless glazing material listed for use in non-impact safety-rated locations such as transoms and borrowed lites with fire rating requirements for 45 minutes with required hose stream test.

2. Passes positive pressure test standards UL 10C.
3. Properties:
    a. Thickness: 3/4 inch [19 mm] overall.
    b. Weight: 9 lbs./sq. ft.
    c. Approximate Visible Transmission: 83 percent.
    d. Approximate Visible Reflection: 9 percent.
    e. Fire-rating: 45 minutes with hose stream.
    f. Impact Safety Resistance: ANSI Z97.1 Class A and B and CPSC 16CFR1201 (Cat. I and II).
    g. STC Rating: Approximately 37 dB.
    h. Surface Finish:
    i. Appearance: clear, wireless and tint-free.
    j. Positive Pressure Test: UL 10C; passes.
4. Maximum sheet sizes based on surface finish:
    a. Premium: 48 inches by 96 inches.
    b. Standard: 48 inches by 96 inches.
5. Labeling: Permanently label each piece with a permanent logo including name of product, manufacturer, testing laboratory, fire rating, period and safety glazing standards.
6. Glazing material installed in Hazardous Locations, subject to human impact, shall be certified and permanently labeled as meeting applicable requirements referenced in NFPA 80: a. CPSC 16 CFR 1201, Cat. I or II.

2.6 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E2190.

1. Sealing System: Dual seals.
2. Perimeter Spacer: Manufacturer's standard spacer material and construction.

    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

        1) Technoform.
        2) Thermix; a brand of Ensinger USA.
        3) Cardinal Glass Industries.

3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.7 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Engineer/Architect from manufacturer's full range.

B. Glazing Sealant:
1. Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 100/50, Use NT.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) Sika Corporation.
2) The Dow Chemical Company.

2.8 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.9 MISCELLANEOUS GLAZING MATERIALS

A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

B. Setting Blocks:

1. EPDM or Silicone with a Shore A durometer hardness of 85, plus or minus 5.
2. Type recommended by sealant or glass manufacturer.

C. Spacers:

1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

2. Type recommended by sealant or glass manufacturer.

D. Edge Blocks:

1. EPDM or Silicone with a Shore A durometer hardness per manufacturer's written instructions.
2. Type recommended by sealant or glass manufacturer.

E. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

PART 3 - EXECUTION

3.1 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.2 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Apply heel bead of elastomeric sealant.

F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.3 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints to be miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.4 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.5 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

3.6 MONOLITHIC GLASS SCHEDULE

A. Glass Type GL-1: Clear annealed float glass.

1. Minimum Thickness: 6 mm.
2. Safety glazing required.

B. Glass Type GL-2: Ultraclear heat-strengthened float glass.

1. Basis-of-Design Product: PPG Industries, Inc.; Starphire.
2. Minimum Thickness: 6 mm.
3. Safety glazing required.

C. Glass Type GL-3: Pyrolytic-coated, self-cleaning, low-maintenance, clear fully tempered float glass.

1. Basis-of-Design Product: Cardinal Glass Industries; Neat.
2. Minimum Thickness: 6 mm.
3. Safety glazing required.

3.7 LAMINATED GLASS SCHEDULE

A. Glass Type GL-4: Clear laminated glass with two plies of ultraclear fully tempered float glass.

1. Basis-of-Design Product: Cardinal Glass
2. Minimum Thickness of Each Glass Ply: 6 mm.
3. Interlayer Thickness: 0.060 inch.
4. Safety glazing required.

3.8 INSULATING GLASS SCHEDULE

A. Glass Type GL-5: Pyrolytic-coated, self-cleaning, low-maintenance, low-E coated, clear insulating glass.

1. Basis-of-Design Product: Cardinal Glass Industries; Neat LoE.
2. Overall Unit Thickness: 1 inch.
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: Pyrolytic-coated, self-cleaning, low-maintenance, annealed float glass.
5. Interspace Content: Argon.
6. Indoor Lite: annealed float glass.
7. Low-E Coating: Pyrolytic or sputtered on second or third surface.
8. Winter Nighttime U-Factor: 0.28 maximum.
9. Summer Daytime U-Factor: 0.25 maximum.
10. Visible Light Transmittance: 72% percent minimum.
11. Solar Heat Gain Coefficient: 0.41 maximum.
12. Safety glazing required.

B. Glass Type GL-6: Pyrolytic-coated, self-cleaning, low-maintenance, low-E coated, clear insulating, tempered safety glass.

1. Basis-of-Design Product: Cardinal Glass Industries; Neat LoE.
2. Overall Unit Thickness: 1 inch.
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: Pyrolytic-coated, self-cleaning, low-maintenance, clear fully tempered float glass.
5. Interspace Content: Argon.
6. Indoor Lite: Fully tempered float glass.
7. Low-E Coating: Pyrolytic or sputtered on second or third surface.
8. Winter Nighttime U-Factor: 0.28 maximum.
9. Summer Daytime U-Factor: 0.25 maximum.
10. Visible Light Transmittance: 72% percent minimum.
11. Solar Heat Gain Coefficient: 0.41 maximum.
12. Safety glazing required.

C. Glass Type GL-7: Silicone-coated, insulating spandrel glass.

1. Basis-of-Design Product: ICD High Performance Coatings, Opaci-Coat 300.
2. Coating Color: As selected by Engineer/Architect from manufacturer's full range.
3. Overall Unit Thickness: 1 inch.
4. Minimum Thickness of Each Glass Lite: 6 mm.
5. Outdoor Lite: fully tempered float glass.
6. Interspace Content: Argon.
7. Indoor Lite: fully tempered float glass.
8. Coating Location: Fourth surface.
9. Winter Nighttime U-Factor: 0.31 maximum.
10. Summer Daytime U-Factor: 0.28 maximum.

END OF SECTION 088000

SECTION 088113.1 - DECORATIVE GLAZING FILM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Decorative Glazing Film Overlay.

1.2 COORDINATION

A. Coordinate glazing sizes to ensure glass can be overlayed with film in one sheet per glass panel.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For decorative glazing film. Show fabrication and installation details.

C. Glass Samples: For each type of decorative glazing film, 12 inches square.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of decorative glazing film overlay.

B. Preconstruction adhesion and compatibility test report.

C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten years experience.
1. Provide documentation that the adhesive used on the specified films is a Pressure Sensitive Adhesive (PSA).

B. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five years demonstrated experience in installing products of the same type and scope as specified.

1. Provide documentation that the installer is authorized by the Manufacturer to perform Work specified in this section.
2. Provide a commercial building reference list of 5 properties where the installer has applied window film. This list will include the following information:
    a. Name of building.
    b. The name and telephone number of a management contact.
    c. Type of glass.
    d. Type of film and/or film attachment system.
    e. Amount of film and/or film attachment system installed.
    f. Date of completion.

C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
1. Finish areas designated by Architect.
2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
3. Refinish mock-up area as required to produce acceptable work.

D. Installer Qualifications: A qualified installer who employs glazing film overlay installers for this Project who are certified to install in accordance with manufacturer’s guidelines.

E. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Follow the Manufacturer’s instructions for storage and handling.

B. Store products in manufacturer's unopened packaging until ready for installation.

C. Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local authorities having jurisdiction.

1.8 PRECONSTRUCTION CONFERENCE

A. Conduct Preconstruction Conference at the site to discuss methods and procedures relating to the installation of glazing film overlays.

1.9 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.10 WARRANTY

A. At project closeout, provide to Owner or Owners Representative an executed current copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

B. In order to validate warranty, installation must be performed by an Authorized 3M dealer and according to Manufacturer's installation instructions. Verification of Authorized 3M dealer can be confirmed by submission of active 3M dealer code number.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Basis of Design:
1. Architectural Finish Films: 3M FASARA Glass Finishes Film as manufactured by 3M Company - Commercial Solutions.

B. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the Basis of design manufacturer. Other available manufacturers offering products that may be incorporated into the work include, but are not limited to the following:
   a. Avery Dennison Graphics.
   b. Eastman Performance Films, LLC.
   c. FDC Graphic Films, Inc.

2.2 MATERIALS:

C. Material Properties:
1. General: Glass and plastic finishes field-applied application to glass or plastic material as visual opaque or decorative film.
2. Film: Polyester.
3. Decorative Pattern: To be selected by architect from manufacturer’s full range of printed patterns and opacities.
4. Adhesive: Acrylic, Pressure Sensitive, Permanent.
5. Liner: Silicone-coated Polyester.
6. Thickness (Average): 3.2 mils (80 microns).
7. Fire Performance: Surface burning characteristics when tested in accordance with ASTM E84: Class A:
   a. Flame Spread: 25 maximum.
   b. Smoke Developed: 55 maximum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Film Examination:
1. If preparation of glass surfaces is the responsibility of another installer, notify Architect in writing of deviations from manufacturer's recommended installation tolerances and conditions.
   a. Glass surfaces receiving new film should first be examined to verify that they are free from defects and imperfections, which will affect the final appearance.

2. Do not proceed with installation until glass surfaces have been properly prepared and deviations from manufacturer's recommended tolerances are corrected. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result under the project conditions.
3. Commencement of installation constitutes acceptance of conditions.

3.2 PREPARATION

1. Clean surfaces thoroughly prior to installation.
2. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
3. Refer to Manufacturer's installation instructions for methods of preparation for Impact Protection Adhesive or Impact Protection Profile film attachment systems.

3.3 INSTALLATION

A. Film Installation, General:
1. Install in accordance with manufacturer's instructions.
2. Cut film edges neatly and square at a uniform distance of 1/8 inch (3 mm) to 1/16 inch (1.5 mm) of window sealant. Use new blade tips after 3 to 4 cuts.
3. Spray the slip solution, composed of one capful of baby shampoo or dishwashing liquid to 1 gallon of water, on window glass & adhesive to facilitate proper positioning of film.
4. Apply film to glass and lightly spray film with slip solution.
5. Squeegee from top to bottom of window. Spray slip solution to film and squeegee a second time.
6. Bump film edge with lint-free towel wrapped around edge of a 5-way tool.
7. Upon completion of film application, allow 30 days for moisture from film installation to dry thoroughly, and to allow film to dry flat with no moisture dimples when viewed under normal viewing conditions.
8. If completing an exterior application, check with the manufacturer as to whether edge sealing is required.

3.4 CLEANING AND PROTECTION

A. Remove left over material and debris from Work area. Use necessary means to protect film before, during, and after installation.

B. Touch-up, repair or replace damaged products before Substantial Completion.

C. After application of film, wash film using common window cleaning solutions, including ammonia solutions, 30 days after application. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching film. Use synthetic sponges or soft cloths.

END OF SECTION 088113.1

SECTION 089119 - FIXED LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes fixed extruded aluminum and formed metal louvers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

C. Samples: For each type of metal finish required.

D. Delegated-Design Submittal: For louvers indicated to comply with structural and seismic performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on tests performed according to AMCA 500-L.

B. Sample warranties.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.5 WARRANTY

A. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural and seismic performance requirements and design criteria indicated.

B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normally to the face of the building.

1. Wind Loads: Determine loads based on pressures as indicated on Drawings.
2. Wind Loads: Determine loads based on a uniform pressure of 20 lbf/sq. ft., acting inward or outward.

C. Seismic Performance: As indicated in the drawings.

D. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. Component Importance Factor: 1.0.

E. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

2.2 FIXED EXTRUDED-ALUMINUM LOUVERS

A. Horizontal Drainable-Blade Louver:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Airolite Company, LLC (The).
b. Greenheck Fan Corporation.
c. Ruskin Company.

2. Louver Depth: 6 inches.
3. Frame and Blade Nominal Thickness: Not less than 0.060 inch for blades and 0.080 inch for frames.
4. Mullion Type: Exposed.
5. Louver Performance Ratings:

a. Free Area: Not less than 8.0 sq. ft for 48-inch-wide by 48-inch-high louver.
b. Point of Beginning Water Penetration: Not less than 700 fpm.
c. Air Performance: Not more than 0.10-inch wg static pressure drop at 700-fpm free-area intake velocity.

d. Air Performance: Not more than 0.15-inch wg static pressure drop at 900-fpm free-area exhaust velocity.

6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.3 LOUVER SCREENS

A. General: Provide screen at louvers indicated.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Bird screening.

B. Louver Screen Frames: Same type and form of metal as indicated for louver to which screens are attached.

C. Louver Screening for Aluminum Louvers:

1. Bird Screening: Aluminum, 1/2-inch-square mesh, 0.063-inch wire.

2.4 MATERIALS

A. Aluminum Extrusions: ASTM B221, Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use tamper-resistant screws for exposed fasteners unless otherwise indicated.
2. For color-finished louvers, use fasteners with heads that match color of louvers.

D. Post installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, fabricated from stainless-steel components, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing according to ASTM E488/E488M conducted by a qualified testing agency.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.5 FABRICATION

A. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

B. Join frame members to each other and to fixed louver blades with fillet welds concealed from view unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.6 ALUMINUM FINISHES

A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

1. Color: Per architectural plans.

B. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 and containing not less than 50 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Engineer/Architect from manufacturer's full range.

2.7 GALVANIZED-STEEL SHEET FINISHES

A. Finish louvers after assembly.

B. Surface Preparation: Clean surfaces with nonpetroleum solvent, so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating compatible with the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and repair according to ASTM A780/A780M.

C. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 2 mils.

1. Color and Gloss: As selected by Engineer/Architect from manufacturer's full range.

2.8 STAINLESS-STEEL SHEET FINISHES

A. Repair sheet finish by grinding and polishing irregularities, weld spatter, scratches, and forming marks to match surrounding finish.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

D. Protect unpainted galvanized- and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

3.2 ADJUSTING

A. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Engineer/Architect, remove damaged units and replace with new units.

END OF SECTION 089119

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Gypsum board, Type X.
2. Mold-resistant gypsum board.
3. Impact-resistant gypsum board.
4. Interior trim.
5. Joint treatment materials.
6. Laminating adhesive.

B. Samples: For each texture finish indicated on same backing indicated for Work.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

B. Gypsum Board, Type X: ASTM C1396/C1396M.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. National Gypsum Company.
    b. USG Corporation.

2. Thickness: 5/8 inch.
3. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

C. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. National Gypsum Company.
    b. USG Corporation.

2. Core: 5/8 inch, Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

D. Impact-Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested in accordance with ASTM C1629/C1629M.

    a. National Gypsum Company.
    b. USG Corporation.
2. Core: 5/8 inch Type X.
3. Surface Abrasion: ASTM C1629/C1629M, meets or exceeds Level 2 requirements.
4. Indentation: ASTM C1629/C1629M, meets or exceeds Level 2 requirements.
5. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 2 requirements.
6. Hard-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 2 requirements in accordance with test in Annex A1.
7. Long Edges: Tapered.
8. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

2.3 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board: ASTM C1178/C1178M, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. National Gypsum Company.
    b. USG Corporation.

2. Core: 5/8 inch, Type X.
3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

B. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. National Gypsum Company.
b. USG Corporation.

2. Thickness: 5/8 inch.
3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.4 METAL SUSPENSION SYSTEM

A. Manufacturers: Basis of Design: USG Drywall Suspension Systems. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Armstrong World Industries, Inc.
2. National Gypsum Services Company

A. Commercial quality, cold-rolled steel, hot dipped galvanized finish.
   1. Main Tees: Fire-Rated Heavy-Duty classification 1.617” high x 144” long, integral reversible splice with knurled face. (DGLW-26 1-1/2” Face and 1.617” high)
      a. Cross Members: Fire-Rated members with knurled face. Cross Tees: DGLW-424 cross tee 1-1/2” high x 48” long with 1-1/2” wide face; DGLW-224 Fire-Rated: 1-1/2” high x 24” long with 1-1/2” face
   2. quick release cross tee ends for positive locking and removability without tools.
   3. Accessory Cross Tees: Cross tees must have knurled faces and quick release cross tee ends for positive locking and removability without tools.
      a. DGW-6026DM: 1.617” high x 5’ long with a 1-1/2” face
      b. DGW-7226DM: 1.617” high x 6’ long with a 1-1/2” face
      c. DGW-8426DM: 1.617” high x 7’ long with a 1-1/2” face
      d. DGW-9626DM: 1.617” high x 8’ long with a 1-1/2” face
   4. Wall Moldings: Single web with knurled face
      a. DGWM-24: 1-1/2” x 1” x 144” long wall molding
      b. DGCM-27: 144” x 1-5/8” x 1” x 1” channel molding
      c. DGLC-12: 144” x 1-3/4” x 1” x 1” index channel molding
   5. Accessories
      a. DGSC-180: Splice Clip
      b. DGTC-90: Transition Clip
      c. DGWC: Wall Attachment Clip
      d. DGSP-180: Splice Plate
      e. DGHUB: Dome Hub
      f. CMAC-1: Close Mount Attachment Clip
   6. Wire: Hanger Wire 12 ga., galvanized or as noted on drawings

B. USG Drywall Wall-to-Wall Suspension Systems – Commercial quality, cold-rolled steel, hot dipped galvanized finish for use in corridors and short span applications.
    1. Main Tees: Fire-Rated Heavy-Duty classification 1.617" high x [6'] [8'] [10'] [12'] [14'] [Custom] long, integral reversible splice with 1-1/2" knurled face.
    2. Wall Moldings: Single web with knurled face, 1-1/2" x 1" x 12' long, DGWM24
    3. Wall Channel: Single web with knurled face, 1-5/8" x 1" x 12' long, DGCM27
    4. Locking Wall Channel: Single web with knurled face, 1-3/4" x 1" x 12' long, DGLC-12

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
2. Shapes:

    a. Cornerbead.
    b. Bullnose bead.
    c. LC-Bead: J-shaped; exposed long flange receives joint compound.
    d. L-Bead: L-shaped; exposed long flange receives joint compound.
    e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
    f. Expansion (control) joint.
    g. Curved-Edge Cornerbead: With notched or flexible flanges.

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.

    a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

2.7 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 INSTALLATION AND FINISHING OF PANELS

A. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

B. Comply with ASTM C840.

C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

D. For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

E. Prefill open joints, rounded or beveled edges, and damaged surface areas.

F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:

1. **Level 1**: Used in ceiling plenum areas, concealed areas, areas not open to public view. All joints and interior angles to have tape embedded in joint compound; tape and fastener heads don’t need to be covered with joint compound. Surface to be free of excess joint compound.
2. **Level 2**: Used with setting-type compound where water resistant gypsum backing board is used as substrate for tile. Garage areas, warehouse storage, or similar areas. All joints and interior angles to have tape embedded in joint compound and have a thin coat of

compound. Fastener heads and accessories to be covered with a coat of joint compound. Surface to be free of excess joint compound.

3. **Level 3**: Used in areas where heavy texture finish will be applied before painting, or where commercial grade wallcoverings are applied as final decoration. All joints and interior angles to have tape embedded in joint compound and have a 2 coats of compound. Fastener heads and accessories to be covered with 2 coats of joint compound. All joints to be smooth and free of tool marks and ridges. Prepared surface to be covered with primer prior to final decoration.
4. **Level 4**: Used where residential grade wall coverings, flat paints, light textures will be applied. All joints and interior angles to have tape embedded in joint compound with a thin coat of compound; Additional coats of compound to be applied, 2 coats on all flat joints and 1 coat over interior angles. Fastener heads and accessories to be covered with 3 coats of joint compound. Joints to be smooth and free of tool marks and ridges. Prepared surface to be covered with primer prior to final decoration. Gloss, semi-gloss, and enamel paints are not recommended for this level.
5. **Level 5**: Used in areas where gloss, semi-gloss, and enamel paints, or flat joints on untextured surface are specified. All joints and interior angles to have tape embedded in joint compound with a thin coat of compound; Additional coats of compound to be applied, 2 coats on all flat joints and 1 coat over interior angles. Fastener heads and accessories to be covered with 3 coats of joint compound. A thin skim coat of joint compound to be trowel applied to entire surface. Surface to be smooth and free of tool marks and ridges. Prepared surface to be covered with primer prior to final decoration.

H. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.

I. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

J. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.2 APPLYING TEXTURE FINISHES

A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.

B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture matching approved mockup and free of starved spots or other evidence of thin application or of application patterns.

3.3 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during the remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900

SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ceramic mosaic tile.
2. Porcelain tile.
3. Stone thresholds.
4. Tile backing panels.
5. Waterproof membrane for thinset applications.
6. Crack isolation membrane.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples:

1. Each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide samples of each color blend.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer is a Five-Star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.
2. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.

3. Installer employs only Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers for Project.
4. Installer employs at least one installer for Project that has completed the Advanced Certification for Tile Installers (ACT) certification for installation of mud floors, mud walls, membranes, shower receptors, gauged porcelain tile/gauged porcelain tile panels and slabs, and large format tile.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of each type of floor tile installation.
2. Build mockup of each type of wall tile installation.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide Standard-grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

2.2 TILE PRODUCTS

A. Ceramic Tile Type CT-1: Factory-mounted unglazed ceramic mosaic tile.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. American Olean; a division of Dal-Tile Corporation.
    b. Daltile.
2. Composition: Vitreous or impervious natural clay or porcelain.
3. Certification: Porcelain tile certified by the Porcelain Tile Certification Agency.
4. Module Size: 2 by 2 inches.
5. Thickness: 1/4 inch.
6. Face: Plain with cushion edges.
7. Surface: Slip resistant, with abrasive admixture.
8. Dynamic Coefficient of Friction: Not less than 0.42.
9. Finish: Mat, opaque glaze.
10. Tile Color and Pattern: As selected by Engineer/Architect from manufacturer's full range.
11. Grout Color: As selected by Engineer/Architect from manufacturer's full range.

12. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

    a. Base Cove: Cove, module size 2 by 1 inch.
    b. Base Cap: Surface bullnose, module size 2 by 2 inches.
    c. Wainscot Cap: Surface bullnose, module size 2 by 2 inches.
    d. External Corners for Thin-set Mortar Installations: Surface bullnose, module size 2 by 2 inches.
    e. Internal Corners: Cove, module size 2 by 1 inch.
    f. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch across nominal 4-inch dimension.

B. Ceramic Tile Type CT-2: Glazed porcelain tile.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. American Olean; a division of Dal-Tile Corporation.
    b. Daltile.
2. Certification: Tile certified by the Porcelain Tile Certification Agency.
3. Face Size: 11-7/8 by 11-7/8 inches “Continental Slate.”
4. Face Size Variation: Rectified.
5. Thickness: 1/4 inch.
6. Face: Plain with square or cushion edges.
7. Dynamic Coefficient of Friction: Not less than 0.42.
8. Tile Color, Glaze, and Pattern: As selected by Architect from manufacturer's full range.
9. Grout Color: As selected by Architect from manufacturer's full range.
10. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

    a. Base Cap: Surface bullnose, module size same as adjoining flat tile.
    b. Wainscot Cap: Surface bullnose, module size same as adjoining flat tile.
    c. External Corners: Surface bullnose, module size same as adjoining flat tile.
    d. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch across nominal 4-inch dimension.

C. Ceramic Tile Type CT-3: Glazed wall tile.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. American Olean; a division of Dal-Tile Corporation.
    b. Daltile.

2. Module Size: 3 by 6 inches.

3. Face Size Variation: Rectified.
4. Thickness: 5/16 inch.
5. Face: Plain with modified square edges or cushion edges.
6. Finish: Bright, clear glaze.
7. Tile Color and Pattern: As selected by Engineer/Architect from manufacturer's full range.
8. Grout Color: As selected by Engineer/Architect from manufacturer's full range.
9. Mounting: Factory, back mounted.
10. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:

    a. Base: Coved, module size 4 by 8 inches.
    b. External Corners: Surface bullnose, same size as adjoining flat tile.
    c. Internal Corners: Field-butted square corners. For coved base and cap use angle pieces designed to fit with stretcher shapes.

2.3 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Double Hollywood Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.

B. Marble Thresholds: ASTM C503/C503M, with a minimum abrasion resistance of 10 according to ASTM C1353 or ASTM C241/C241M and with honed finish.

1. Description: Uniform, fine- to medium-grained white stone with gray veining.

2.4 TILE BACKING PANELS - WALLS

A. Cementitious Backer Units: ANSI A118.9 or ASTM C1325, Type A.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. C-Cure.
    b. Custom Building Products.
    c. FinPan, Inc.
    d. Georgia-Pacific Gypsum LLC.
    e. USG Corporation.
2. Thickness: 5/8 inch for use on walls.

B. Fiber-Cement Backer Board: ASTM C1288.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. CertainTeed Corporation.
    b. Custom Building Products.
    c. James Hardie Building Products, Inc.

2. Thickness: 1/4 inch for use over plywood sub-floor.

2.5 WATERPROOF MEMBRANE

A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Composite polypropylene waterproof sheet mat: Polyethylene faced on both sides with fleece webbing; 0.5 mm nominal thickness.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Dural USA, Inc.

2. Basis of Design – FLOORS -: DURABASE WP Waterproof Sealing Mat composite sheet waterproofing membrane to be used behind all floor tile. Install as per all manufacturer’s installation requirements with seam tape at all joints, intersections, penetrations, etc., as manufactured by Dural, or approved equal.

2.6 CRACK ISOLATION MEMBRANE

A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Polypropylene membrane to be 0.5 mm thick sheets with structure of square grid structure of setback cavities and an anchoring fleece laminated to the top and bottom sides.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Dural USA, Inc.

2. Basis of Design – FLOORS -: DURABASE WP Waterproof Sealing Mat composite sheet waterproofing membrane to be used behind all floor tile. Install as per all manufacturer’s installation requirements with seam tape at all joints, intersections, penetrations, etc., as manufactured by Dural, or approved equal.

2.7 SETTING MATERIALS

A. Improved Modified Dry-Set Mortar (Thinset): ANSI A118.15.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Bonsal American, an Oldcastle company.
    b. LATICRETE SUPERCAP, LLC.
    c. MAPEI Corporation.
2. Provide prepackaged, dry-mortar mix to which only water must be added at Project site.
3. For wall applications, provide nonsagging mortar.

2.8 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.

B. High-Performance Tile Grout: ANSI A118.7.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Schluter Systems L.P.

    b. Bonsal American, an Oldcastle company.
    c. LATICRETE SUPERCAP, LLC.
    d. MAPEI Corporation.
    e. Dural USA, Inc
2. Polymer Type: Dry, redispersible form, prepackaged with other dry ingredients.

2.9 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Bonsal American, an Oldcastle company.
    b. Custom Building Products.
    c. Jamo Inc.
    d. Southern Grouts & Mortars, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with adhesives bonded mortar bed or thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
    a. Tile floors in wet areas.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Where accent tile differs in thickness from field tile, vary setting bed thickness so that tiles are flush.

F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Ceramic Mosaic Tile: 1/8 inch.
2. Quarry Tile: 1/4 inch.
3. Glazed Wall Tile: 1/16 inch.

H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

J. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in improved modified dry-set mortar (thinset).
2. Do not extend cleavage membrane, waterproof membrane or crack isolation membrane under thresholds set in standard dry-set, modified dry-set or improved modified dry-set mortar. Fill joints between such thresholds and adjoining tile set on cleavage membrane, waterproof membrane or crack isolation membrane with elastomeric sealant.

K. Floor Sealer: Apply floor sealer to cementitious grout joints in tile floors according to floor-sealer if cementitious grout utilizes manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

L. Install tile backing panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use modified dry-set mortar for bonding material unless otherwise directed in manufacturer's written instructions.

M. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

N. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

3.4 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

1. Ceramic Tile Installation CT-1: TCNA F113; thin-set mortar.

    a. Ceramic Tile Type: CT-1.
    b. Thin-set Mortar: Improved modified dry-set mortar.
    c. Grout: High-performance unsanded grout.

2. Ceramic Tile Installation CT-1: TCNA F125-Partial; thin-set mortar on crack isolation membrane or waterproofing membrane.

    a. Ceramic Tile Type: CT-1.
    b. Thin-set Mortar: Improved modified dry-set mortar.
    c. Grout: High-performance unsanded grout.

B. Interior Wall Installations, Wood or Metal Studs or Furring:

1. Ceramic Tile Installation CT-3: TCNA W244C or TCNA W244F; thin-set mortar on cementitious backer units or fiber-cement backer board over vapor-retarder membrane.

    a. Ceramic Tile Type: CT-3.
    b. Thin-set Mortar: Improved modified dry-set mortar.
    c. Grout: High-performance unsanded grout.

END OF SECTION 093013

SECTION 095123 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Acoustical tiles for interior ceilings.
2. Fully concealed, direct-hung, suspension systems.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at a location to be determined.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

C. Delegated-Design Submittal: For seismic restraints for ceiling systems.

1. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, and coordinated with each other, using input from installers of the items involved.

B. Product test reports.

C. Research reports.

D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design seismic restraints for ceiling systems.

B. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

C. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class A according to ASTM E1264.
2. Smoke-Developed Index: 50 or less.

2.2 ACOUSTICAL TILES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Armstrong World Industries, Inc.
2. CertainTeed Corporation.
3. USG Corporation.

B. Acoustical Tile Standard: Manufacturer's standard tiles of configuration indicated that comply with ASTM E1264.

C. Classification: Type III, Form 2, Pattern CD, Item No. 1756 (24x24x7/8” Tile), Item No. 1757 (24x48x7/8” Tile).

D. Color: White.

E. Light Reflectance (LR): 0.86.

F. Ceiling Attenuation Class (CAC): 35.

G. Noise Reduction Coefficient (NRC): 0.75.

H. Articulation Class (AC): 170.

I. Edge/Joint Detail: Angled Tegular.

J. Thickness: 15/16”.

K. Modular Size: As indicated on Drawings.

2.3 ACOUSTICAL TILES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Armstrong World Industries, Inc.
2. CertainTeed Corporation.
3. USG Corporation.

B. Basis of Design: Armstrong Lumawash

C. Acoustical Tile Standard: Manufacturer's standard tiles of configuration indicated that comply with ASTM E1264.

D. Classification: Type III, Form 2, Pattern CD, Item No. 973 (24x24x7/8" Tile), Item No. 972 (24x48x7/8" Tile).

E. Color: White.

F. Light Reflectance (LR): 0.89.

G. Ceiling Attenuation Class (CAC): 33.

H. Noise Reduction Coefficient (NRC): 0.70.

I. Articulation Class (AC): 170.

J. Edge/Joint Detail: Square edge.

K. Thickness: 15/16".

L. Modular Size: As indicated on Drawings.

M. Smooth face texture with superior sag and mold resistance meeting USDA / FSIS

2.4 METAL SUSPENSION SYSTEM

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Armstrong World Industries, Inc.
2. USG Corporation.

B. Metal Suspension-System Standard: Manufacturer's standard, direct-hung, fully concealed, metal suspension system that complies with applicable requirements in ASTM C635/C635M.

C. Direct-Hung, Double-Web Suspension System: Main and cross runners roll formed from and capped with cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation.

1. Structural Classification: Intermediate-duty system.

2.5 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

B. Seismic Clips: Manufacturer's standard seismic clips designed to secure acoustical tiles in place during a seismic event.

2.6 METAL EDGE MOLDINGS AND TRIM

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Armstrong World Industries, Inc.
2. CertainTeed Corporation.
3. USG Corporation.

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations complying with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for of suspension-system runners.

PART 3 - EXECUTION

3.1 PREPARATION

A. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders unless otherwise indicated.

B. Layout openings for penetrations centered on the penetrating items.

3.2 INSTALLATION OF SUSPENDED ACOUSTICAL TILE CEILINGS

A. Install suspended acoustical tile ceilings according to ASTM C636/C636M, seismic design requirements, and manufacturer's written instructions.

B. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical tiles.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Do not use exposed fasteners, including pop rivets, on moldings and trim.

C. Arrange directionally patterned acoustical tiles as indicated on reflected ceiling plans.

3.3 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform inspections:

1. Periodic inspection during the installation of suspended ceiling grids according to ASCE/SEI 7 – if required by authority having jurisdiction.

END OF SECTION 095123

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Vinyl base.
   2. Vinyl molding accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 VINYL BASE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   1. Armstrong World Industries, Inc.
   2. Burke Mercer Flooring Products; a division of Burke Industries Inc.
   3. Johnsonite; a Tarkett company.

B. Product Standard: ASTM F1861, Type TV (vinyl, thermoplastic).

   1. Group: I (solid, homogeneous).

   2. Style to be Cove in areas with carpet or with resilient floor coverings.

C. Minimum Thickness: 0.125 inch.

D. Height: 4 inches.

E. Lengths: Coils in manufacturer's standard length.

F. Outside and Inside Corners: Preformed.

G. Colors and Patterns: As selected by Engineer/Architect from manufacturer’s full range.

2.3 VINYL MOLDING ACCESSORY

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Burke Mercer Flooring Products; a division of Burke Industries Inc.
2. Johnsonite; a Tarkett company.

B. Description: Vinyl transition strips.

C. Profile and Dimensions: As indicated.

D. Locations: Provide vinyl molding accessories in areas indicated.

E. Colors and Patterns: As selected by Engineer/Architect from manufacturer’s full range.

2.4 THERMOSET RUBBER BASE

A. Basis of Design: Premium TS Molded Wall Base to be Burke Base by Mannington Commercial.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Armstrong World Industries, Inc.
2. Burke Mercer Flooring Products; a division of Burke Industries Inc.
3. Johnsonite; a Tarkett company.

C. Product Standard: ASTM F1861, Type TP, Group 1 thermoplastic rubber.

1. Group: I (solid, homogeneous).
2. Style to be Cove in areas with Rubber athletic floor coverings.

D. Minimum Thickness: 0.125 inch.

E. Height: 4 inches.

F. Lengths: Coils in manufacturer's standard length.

G. Outside and Inside Corners: Preformed.

H. Colors and Patterns: As selected by Engineer/Architect from manufacturer’s full range.

2.5 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

C. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient stair-tread manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 10 pH.
4. Moisture Testing: Perform tests so that each test area does not exceed 300 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient products until materials are the same temperature as space where they are to be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.2 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

H. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 12 inches in length.

    a. Form without producing discoloration (whitening) at bends.

2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 12 inches in length.

    a. Miter corners to minimize open joints.

3.3 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips and or transition stips at edges of floor covering that would otherwise be exposed.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Floor Polish: Remove soil, adhesive, and blemishes from resilient stair treads before applying liquid floor polish.

1. Apply two coat(s).

C. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vinyl composition floor tile.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and pattern specified.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 VINYL COMPOSITION FLOOR TILE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Armstrong World Industries, Inc.
2. Congoleum Corporation.

B. Tile Standard: ASTM F1066, Class 2, through pattern.

C. Wearing Surface: Smooth.

D. Thickness: 0.125 inch.

E. Size: 12 by 12 inches.

F. Colors and Patterns: Color as selected by Engineer/Architect from manufacturer's full range of colors. Patterns designated on drawings.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 10 pH.
4. Moisture Testing: Perform tests so that each test area does not exceed 300 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

    a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    b. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 95 percent relative humidity level measurement.

C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.

D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

E. Do not install floor tiles until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

F. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.2 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles square with room axis.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles with grain direction alternating in adjacent tiles.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

I. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.

1. Apply two coats immediately after installation to protect during construction.

2. Apply three coats after final cleaning for final floor finish.

END OF SECTION 096519

SECTION 098116 – ACOUSTIC BLANKET INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Mineral-wool blanket insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Mineral-wool blanket insulation.

1.3 INFORMATIONAL SUBMITTALS

A. Installer's Certification: Listing type, manufacturer, and Acoustical Performance of insulation installed in each element of the building, ie. walls, ceilings, etc.

   1. Sign, date, and post the certification in a conspicuous location on Project site.

B. Product test reports.

C. Research reports.

PART 2 - PRODUCTS

2.1 MINERAL-WOOL BLANKET INSULATION

A. Mineral-Wool Blanket Insulation, Unfaced: ASTM C665, Type I (blankets without membrane facing); consisting of fibers; passing ASTM E136 for combustion characteristics.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. Johns Manville; a Berkshire Hathaway company.
      b. Rockwool International.
      c. Thermafiber, Inc.; an Owens Corning company.

   2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
   3. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.
   4. Labeling: Provide identification of mark indicating Acoustical Performance of each piece of insulation 12 inches and wider in width.
   5. Acoustical Performance: Thickness 3”, 125Hz-0.52, 250Hz-0.96, 500Hz-1.18, 1000Hz-1.07, 2000Hz-1.05, 4000Hz-1.05, NRC-1.05 ASTM C423

2.2 ACCESSORIES

A. Insulation for Miscellaneous Voids:

1. Mineral Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.

B. Insulation Anchors, Spindles, and Standoffs: As recommended by manufacturer.

C. Adhesive for Bonding Insulation: Product compatible with insulation and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Install insulation delivered to site in manufacturer's labeled packaging indicating Acoustic Performance.

D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve Acoustic Performance.

3.2 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends, with no voids.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For wood-framed construction, install blankets according to ASTM C1320 and as follows:

a. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Mineral Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..

END OF SECTION 072100

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following exterior substrates:

1. Concrete.
2. Fiber-cement board and trim.
3. Clay masonry.
4. Concrete masonry units (CMUs).
5. Steel and iron.
6. Aluminum (not anodized or otherwise coated).
7. Wood.
8. Gypsum board.

1.2 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.

B. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

C. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.

D. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.

E. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.

F. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.

B. Samples: For each type of paint system and each color and gloss of topcoat.

1.4 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Sherwin-Williams Company (The).
2. Benjamin Moore & Co.
3. Coronado Paint; Benjamin Moore & Co.
4. PPG Paints.
5. Rust-Oleum Corporation; a subsidiary of RPM International, Inc.

B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include but are not limited to products listed in the Exterior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. Colors: As selected by Architect from manufacturer's full range.

1. Twenty percent of surface area will be painted with deep tones.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Fiber-Cement Board: 12 percent.
3. Masonry (Clay and CMUs): 12 percent.
4. Wood: 15 percent.
5. Portland Cement Plaster: 12 percent.
6. Gypsum Board: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."

B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINTING SCHEDULE

A. Concrete Cementitious Siding, Nontraffic Surfaces:

1. Latex System:

a. Prime Coat: Primer sealer, latex.

1) S-W Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils wet, 3.2 mils dry.

b. Prime Coat: Latex, exterior, matching topcoat.
c. Intermediate Coat: Latex, exterior, matching topcoat.
d. Topcoat: Latex, exterior, flat.

1) S-W A-100 Exterior Latex Flat, A6 Series, at 4.0 mils wet, 1.2 mils dry, per coat.

e. Topcoat: Latex, exterior, low sheen.

1) S-W A-100 Exterior Latex Low Sheen, A12 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

f. Topcoat: Latex, exterior, satin.

1) S-W A-100 Exterior Latex Satin, A82 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

g. Topcoat: Latex, exterior, semi-gloss.

1) S-W Solo Acrylic Semi-Gloss, A76 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

h. Topcoat: Latex, exterior, gloss.

1) S-W A-100 Exterior Latex Gloss, A8 Series, at 4.0 mils wet, 1.3 mils dry, per coat.

2. Latex over Latex Aggregate System:

a. Prime Coat: Block Filler, Latex, Interior/Exterior.

1) S-W Loxon Block Surfacer, A24W200, at 50 to 100 sq. ft. per gal. .

b. Topcoat: Latex, exterior flat, coarse texture.

1) S-W UltraCrete Textured Masonry Topcoat, A44-800 Series, 50 to 80 sq. ft. per gal. .

3. Concrete Stain System (Water-based):

a. First Coat: Low-luster opaque finish matching topcoat.
b. Topcoat: Low-luster opaque finish:

1) S-W H&C Colortop Water-Based Solid Color Concrete Stain, at 50 to 250 sq. ft. per gal.

B. Concrete Substrates, Pedestrian Traffic Surfaces:

1. Latex Floor Paint System:

a. First Coat: Floor paint, latex, slip-resistant, matching topcoat.
b. Topcoat: Floor paint, latex, slip-resistant, low gloss.

1) S-W ArmorSeal Tread-Plex, B90 Series, at 1.5 to 2.0 mils dry per coat.

2. Concrete Stain System (Water-based) for Vertical Surfaces:

a. First Coat: Low-luster opaque finish matching top coat.
b. Topcoat: Low-luster opaque finish.

1) S-W H&C Colortop Water-Based Solid Color Concrete Stain, at 50 to 250 sq. ft. per gal. .

C. CMU Substrates:

1. Latex System:

a. Block Filler: Block filler, latex, interior/exterior:

1) S-W PrepRite Block Filler, B25W25, at 75 to 125 sq. ft. per gal..

b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior, flat.

1) S-W A-100 Exterior Latex Flat, A6 Series, at 4.0 mils wet, 1.2 mils dry, per coat.

d. Topcoat: Latex, exterior, low sheen.

1) S-W A-100 Exterior Latex Low Sheen, A12 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

e. Topcoat: Latex, exterior, satin.

1) S-W A-100 Exterior Latex Satin, A82 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

f. Topcoat: Latex, exterior, semi-gloss.

1) S-W Solo Acrylic Semi-Gloss, A76 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

g. Topcoat: Latex, exterior, gloss.

1) S-W A-100 Exterior Latex Gloss, A8 Series, at 4.0 mils wet, 1.3 mils dry, per coat.

2. CMU Stain System (Water-Based):

a. First Coat: Low-luster opaque finish matching topcoat.
b. Topcoat: Low-luster opaque finish.

1) S-W H&C Colortop Water-Based Solid Color Concrete Stain, at 50 to 250 sq. ft. per gal. .

D. Ferrous Metal and Aluminum Substrates:

1. Water-Based Light Industrial Coating System:

a. Prime Coat: Primer, water based.

1) S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, 5.0 to 10.0 mils wet, 2.0 to 4.0 mils dry.

b. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
c. Topcoat: Light industrial coating, exterior, water based eggshell.

1) S-W Pro Industrial Eg-Shel Acrylic B66-660 Series, at 2.5 to 4.0 mils dry, per coat.

d. Topcoat: Light industrial coating, exterior, water based, semi-gloss.

1) S-W Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series, at 2.5 to 4.0 mils dry, per coat.

e. Topcoat: Light industrial coating, exterior, water based, gloss.

1) S-W Pro Industrial Acrylic Gloss Coating, B66-600 Series, at 2.5 to 4.0 mils dry, per coat.

E. Wood Substrates: Including exposed wood items not indicated to receive shop-applied finish.

1. Latex System:

a. Prime Coat: Primer, latex for exterior wood.

1) S-W Exterior Latex Primer, B42, at 4.0 mils wet, 1.4 mils dry, per coat.

b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior, flat:

1) S-W A-100 Exterior Latex Flat, A6 Series, at 4.0 mils wet, 1.2 mils dry, per coat.

d. Topcoat: Latex, exterior, low-sheen:

1) S-W A-100 Exterior Latex Low Sheen, A12 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

e. Topcoat: Latex, exterior, satin:

1) S-W A-100 Exterior Latex Satin, A82 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

f. Topcoat: Latex, exterior, semi-gloss:

1) S-W Solo Acrylic Semi-Gloss, A76 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

g. Topcoat: Latex, exterior, gloss:

1) S-W A-100 Exterior Latex Gloss, A8 Series, at 4.0 mils wet, 1.3 mils dry, per coat.

F. Wood Substrates, Pedestrian Traffic Surfaces:

1. Latex Floor Paint System:

a. First Coat: Floor paint, latex, slip-resistant, matching topcoat.
b. Topcoat: Floor paint, latex, slip-resistant, low gloss:

1) S-W ArmorSeal Tread-Plex, B90 Series, at 1.5 to 2.0 mils dry per coat.

2. Solid Color Stain System:

a. First Coat: Solid color stain, latex, matching topcoat.
b. Topcoat: Solid color stain, latex, slip-resistant, flat, interior/exterior:

1) S-W SuperDeck Exterior Acrylic Solid Color Deck, SD7-Series, at 200 to 400 sq. ft. per gal..

G. Plastic Trim Fabrication Substrates: Including architectural PVC, plastic, and fiberglass items.

1. Latex System:

a. Prime Coat: Primer, bonding, water-based:

1) S-W PrepRite ProBlock Latex Primer/Sealer, B57-620 Series, at 4.0 mils wet, 1.4 mils dry.

b. Intermediate Coat: Latex, exterior, matching topcoat.

a. Topcoat: Latex, exterior, flat:

1) S-W A-100 Exterior Latex Flat, A6 Series, at 4.0 mils wet, 1.2 mils dry, per coat.

b. Topcoat: Latex, exterior, low-sheen:

1) S-W A-100 Exterior Latex Low Sheen, A12 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

c. Topcoat: Latex, exterior, satin:

1) S-W A-100 Exterior Latex Satin, A82 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

d. Topcoat: Latex, exterior, semi-gloss:

1) S-W Solo Acrylic Semi-Gloss, A76 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

e. Topcoat: Latex, exterior, gloss:

1) S-W A-100 Exterior Latex Gloss, A8 Series, at 4.0 mils wet, 1.3 mils dry, per coat.

H. Exterior Gypsum Board Substrates:

1. Latex System:

a. Prime Coat: Primer bonding, water-based.

1) S-W PrepRite ProBlock Latex Primer/Sealer, B57-620 Series, at 4.0 mils wet, 1.4 mils dry.

b. Intermediate Coat: Latex, exterior, matching topcoat.

c. Topcoat: Latex, exterior, flat.

1) S-W A-100 Exterior Latex Flat, A6 Series, at 4.0 mils wet, 1.2 mils dry, per coat.

d. Topcoat: Latex, exterior, low-sheen.

1) S-W A-100 Exterior Latex Low Sheen, A12 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

e. Topcoat: Latex, exterior, satin:

1) S-W A-100 Exterior Latex Satin, A82 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

f. Topcoat: Latex, exterior, semi-gloss.

1) S-W Solo Acrylic Semi-Gloss, A76 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

g. Topcoat: Latex, exterior, gloss.

1) S-W A-100 Exterior Latex Gloss, A8 Series, at 4.0 mils wet, 1.3 mils dry, per coat.

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Concrete.
2. Clay masonry.
3. Concrete masonry units (CMU).
4. Steel.
5. Cast iron.
6. Galvanized metal.
7. Aluminum (not anodized or otherwise coated).
8. Wood.
9. Gypsum board.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this section.
2. Section 099113 "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Indicate VOC content.

B. Sustainable Design Submittals:

1. Product Data for LEED 2009 Credit EQ 4.2: For paints and coatings, showing printed statement of VOC content.
2. Laboratory Test Reports: For paints and coatings, indicating compliance with LEED 2009 Credit EQ 4.2 requirements for low-emitting materials.

C. Samples for Initial Selection: For each type of topcoat product.

D. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Label each coat of each Sample.
3. Label each Sample for location and application area.

E. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Indicate VOC content.

1.4 CLOSEOUT SUBMITTALS

1. Coating Maintenance Manual: Provide coating maintenance manual including area summary with finish schedule, area detail designating location where each product/color/finish was used, product data pages, material safety data sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 1 gal. of each material and color applied.

1.6 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Handling: Deliver products to Project site in an undamaged condition in manufacturer's original sealed containers, complete with labels and instructions for handling, storing, unpacking, protecting, and installing. Packaging shall bear the manufacturer’s label with the following information:

1. Product name and type (description).
2. Batch date.
3. Color number.
4. VOC content.
5. Environmental handling requirements.
6. Surface preparation requirements.
7. Application instructions.

B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

C. Lead Paint: It is not expected that lead paint will be encountered in the Work.

1. If suspected lead paint is encountered, do not disturb; immediately notify Architect and Owner.

D. Lead Paint: Lead paint may be present in buildings and structures to be painted. A report on the presence of lead paint is on file for review and use. Examine report to become aware of locations where lead paint is present.

1. Do not disturb lead paint or items suspected of containing hazardous materials except under procedures specified.
2. Perform preparation for painting of substrates known to include lead paint in accordance with EPA Renovation, Repair and Painting Rule and additional requirements of authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The); products indicated or comparable product from one of, but not necessarily limited to, the following:

1. Benjamin Moore

2. PPG Industries Inc.

B. Comparable Products: Comparable products of approved manufacturers will be considered in accordance with Section 016000 "Product Requirements," and the following:

1. Products are approved by manufacturer in writing for application specified.
2. Products meet performance and physical characteristics of basis of design product including published ratio of solids by volume, plus or minus two percent.

C. Source Limitations: Obtain paint materials from single source from single listed manufacturer.

1. Manufacturer's designations listed on a separate color schedule are for color reference only and do not indicate prior approval.

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. VOC Content: For field applications that are inside the weatherproofing system, paints and coatings shall provide materials that comply with VOC limits of authorities having jurisdiction and for interior paints and coatings applied at Project site, the following VOC limits exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Primers, Sealers, and Undercoaters: 200 g/L.
4. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
5. Floor Coatings: 100 g/L.
6. Shellacs, Clear: 730 g/L.
7. Shellacs, Pigmented: 550 g/L.

C. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the

Testing of Volatile Organic Emissions from Various Sources Using Small Scale Environmental Chambers."

D. Colors: As selected by Architect from manufacturer's full range.

1. 20 percent of surface area will be painted with deep tones.

2.3 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers. Where acceptability of substrate conditions is in question, apply samples and perform in-situ testing to verify compatibility, adhesion, and film integrity of new paint application.

1. Report, in writing, conditions that may affect application, appearance, or performance of paint.

B. Substrate Conditions:

1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

a. Concrete: 12 percent.
b. Masonry (Clay and CMU): 12 percent.
c. Wood: 15 percent.
d. Gypsum Board: 12 percent.
e. Plaster: 12 percent.

2. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

3. Plaster Substrates: Verify that plaster is fully cured.
4. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.

C. Proceed with coating application only after unsatisfactory conditions have been corrected; application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

1. Concrete Floors: Remove oil, dust, grease, dirt, and other foreign materials. Comply with SSPC-SP-13/NACE 6 or ICRI 03732.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."
3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

I. Aluminum Substrates: Remove loose surface oxidation.

J. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

K. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms:

a. Equipment, including panelboards and switch gear.
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.

f. Plastic conduit.
g. Tanks that do not have factory-applied final finishes.
h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.

2. Paint the following work where exposed in occupied spaces:

a. Equipment, including panelboards.
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
h. Other items as directed by Architect.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR MICROBICIDAL PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces and Clay Masonry:

1. Microbicidal Latex Finish System: With topcoat EPA registered No. 64695-1.

    a. Prime Coat: Primer sealer, latex, interior:

        1) S-W Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils wet, 3.2 mils dry.

    b. First Coat: Microbicidal Latex, interior, matching topcoat.
    c. Topcoat: Microbicidal Latex, interior, eggshell:

        1) S-W Paint Shield Interior Latex Eg-Shel Microbicidal Paint, D12W51, at 4.0 mils wet, 1.8 mils dry, per coat. Brush and roll application only.

B. CMU Substrates:

1. Microbicidal Latex Finish System: With topcoat EPA registered No. 64695-1.
    a. Block Filler: One or two coats as required: Block filler, latex, interior/exterior:

        1) S-W Loxon Block Surfacer, A24W200, at 10.0 mil wet, 8.0 mils dry, per coat.

    b. First Coat: Microbicidal Latex, interior, matching topcoat.
    c. Topcoat: Microbicidal Latex, interior, eggshell:

        1) S-W Paint Shield Interior Latex Eg-Shel Microbicidal Paint, D12W51, at 4.0 mils wet, 1.6 mils dry, per coat. Brush and roll application only.

C. Wood Substrates: Including exposed wood items not indicated to receive shop-applied finish.

1. Microbicidal Latex Finish System: With topcoat EPA registered No. 64695-1.

    a. Prime Coat: Primer, latex, interior, anti-microbial:

        1) S-W PrepRite ProBlock Interior/Exterior Latex Primer/Sealer, at 4.0 mils wet, 1.5 mils dry.

    b. First Coat: Microbicidal Latex, interior, matching topcoat.
    c. Topcoat: Microbicidal Latex, interior, eggshell:

        1) S-W Paint Shield Interior Latex Eg-Shel Microbicidal Paint, D12W51, at 4.0 mils wet, 1.8 mils dry, per coat. Brush and roll application only.

D. Gypsum Board and Plaster Substrates:

1. Microbicidal Latex Finish System: With topcoat EPA registered No. 64695-1.

    a. Prime Coat: Primer, latex, interior:

        1) S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils wet, 1.0 mils dry.

    b. First Coat: Microbicidal Latex, interior, matching topcoat.

c. Topcoat: Microbicidal Latex, interior, eggshell:

1) S-W Paint Shield Interior Latex Eg-Shel Microbicidal Paint, D12W51, at 4.0 mils wet, 1.8 mils dry, per coat. Brush and roll application only.

3.7 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces and Clay Masonry:

1. Latex System:

a. Prime Coat: Primer, latex, interior.

1) S-W Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils wet, 3.2 mils dry.

b. Intermediate Coat: Latex, interior, matching topcoat.

c. Topcoat: Latex, interior, flat.

1) S-W ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.

d. Topcoat: Latex, interior, low sheen.

1) S-W ProMar 200 Zero VOC Latex Low Sheen Eg-Shel, B24-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.

e. Topcoat: Latex, interior, eggshell.

1) S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat .

f. Topcoat: Latex, interior, semi-gloss.

1) S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat .

g. Topcoat: Latex, interior, gloss.

1) S-W ProMar 200 Zero VOC Gloss, B21-12650 Series, at 4.0 mils wet, 1.4 mils dry, per coat.

B. Concrete Substrates, Pedestrian Traffic Surfaces:

1. Latex Floor Enamel System:

a. First Coat: Floor paint, latex, slip-resistant, matching topcoat.
b. Topcoat: Floor paint, latex, slip-resistant, low gloss: S-W ArmorSeal Tread-Plex, B90 Series, at 1.5 to 2.0 mils dry per coat.

2. Clear Acrylic System, Gloss Finish:

a. First Coat:

1) S-W H&C Clarishield Water-Based Wet-Look Concrete Sealer, at 100 to 200 sq. ft. per gal.

b. Second Coat:

1) S-W H&C Clarishield Water-Based Wet-Look Concrete Sealer, at 100 to 200 sq. ft. per gal.

3. Concrete Stain System (Water-based):

a. First Coat: Low-luster opaque finish:

1) S-W H&C Colortop Water-Based Solid Color Concrete Stain, at 50 to 300 sq. ft. per gal.

b. Second Coat: Low-luster opaque finish:

1) S-W H&C Colortop Water-Based Solid Color Concrete Stain, at 50 to 300 sq. ft. per gal.

C. CMU Substrates:

1. Latex System:

a. Block Filler: Block filler, latex, interior/exterior:

1) S-W PrepRite Block Filler, B25W25, at 75-125 sq. ft. per gal.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat:

1) S-W ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.

d. Topcoat: Latex, interior, low sheen:

1) S-W ProMar 200 Zero VOC Latex Low Sheen Enamel, B24-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.

e. Topcoat: Latex, interior, eggshell:

1) S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.

f. Topcoat: Latex, interior, semi-gloss:

1) S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.

g. Topcoat: Latex, interior, gloss:

1) S-W ProMar 200 Zero VOC Gloss, B21-12650 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

D. Metal Substrates (Aluminum, Steel, Galvanized Steel):

1. Latex System:

a. Prime Coat: Primer, rust-inhibitive, water based:

1) S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10 mils wet, 2.0 to 4.0 mils dry.

b. Intermediate Coat: Water-based acrylic, interior, matching topcoat.
c. Topcoat: Water-based acrylic, semi-gloss:

1) S-W Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series, at 2.5 to 4.0 mils dry, per coat.

d. Topcoat: Water-based acrylic, gloss:

1) S-W Pro Industrial Acrylic Gloss Coating, B66-660 Series, at 2.5 to 4.0 mils dry, per coat.

2. Water-Based Dry-Fall System:

a. Top Coat: Dry-fall latex, flat:

1) S-W Pro Industrial Waterborne Acrylic Dryfall Flat, B42-181 Series, at 6.0 mils wet, 1.5 mils dry.

b. Top Coat: Dry-fall latex, eggshell:

1) S-W Pro Industrial Waterborne Acrylic DryFall Eg-Shel, B42-82, at 6.0 mils wet, 1.9 mils dry.

c. Top Coat: Dry-fall latex, semi-gloss:

1) S-W Pro Industrial Waterborne Acrylic DryFall Semi-Gloss, B42-83, at 5.8 mils wet, 2.3 mils dry.

3. Waterbased/Alkyd Urethane System:

a. Prime Coat:

1) S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10 mils wet, 2.0 to 4.0 mils dry.

b. Intermediate Coat: Water-based acrylic-alkyd, interior, matching topcoat.
c. Topcoat: Water-based alkyd-urethane, semi-gloss, interior:

1) S-W Pro Industrial Waterbased Alkyd Urethane Semi-Gloss, B53-1150 Series, at 4.0 mils wet, 1.4 mils dry, per coat.

d. Topcoat: Water-based alkyd-urethane, gloss, interior:

1) S-W Pro Industrial Waterbased Alkyd Urethane Gloss, B53-1050 Series, at 4.0 mils wet, 1.4 mils dry, per coat.

E. Wood Substrates: Including exposed wood items not indicated to receive shop-applied finish.

1. Latex System:

a. Prime Coat: Primer sealer, latex, interior:

1) S-W PrepRite ProBlock Primer Sealer, B51-620 Series, at 4.0 mils wet, 1.4 mils dry.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, eggshell:

1) S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.

d. Topcoat: Latex, interior, semi-gloss:

1) S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.

e. Topcoat: Latex, interior, gloss:

1) S-W ProMar 200 Zero VOC Gloss, B21-12650 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

F. Gypsum Board and Plaster Substrates:

1. Latex System:

a. Prime Coat: Primer, latex, interior:

1) S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils wet, 1.0 mils dry.

b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat:

1) S-W ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.

d. Topcoat: Latex, interior, low sheen:

1) S-W ProMar 200 Zero VOC Latex Low Sheen Enamel, B24-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.

e. Topcoat: Latex, interior, eggshell:

1) S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.

f. Topcoat: Latex, interior, semi-gloss:

1) S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.

g. Topcoat: Latex, interior, gloss:

1) S-W ProMar 200 Zero VOC Gloss, B21-12650 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

END OF SECTION 099123

SECTION 099600 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY:

A. This Section includes surface preparation and field application of high-performance coating systems to process related items including but not limited to ferrous pipes, valves, flanges, and pipe supports. Non-process related items such as metal roofs, roof trusses, door frames, louvers, plumbing piping, ductwork, etc. are excluded or as specified in the respective sections of the project manual.

B. Related Sections include the following:

1. Division 9 Section "Painting" for general field painting.
2. Section 400508 – “Process Piping Identification”

1.3 DEFINITIONS:

A. Standard coating terms defined in ASTM D 16 apply to this Section.

B. Gloss ranges used in this Section include the following:

1. Semigloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degree meter.
2. High gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60-degree meter.

C. Environments: The following terms are used in Part 2 of this Section to distinguish between different corrosive exposures:

1. "Severe environments" are highly corrosive industrial atmospheres with sustained exposure to submergence, high humidity and condensation and with frequent cleaning using strong chemicals. Environments with heavy concentrations of strong chemical fumes and frequent splashing and spilling of harsh chemical products are severe environments.
2. "Moderate environments" are corrosive industrial atmospheres with intermittent exposure to high humidity and condensation, occasional mold and mildew development, and regular cleaning with strong chemicals. Environments with exposure to heavy concentrations of chemical fumes and occasional splashing and spilling of chemical products are moderate environments.

3. "Mild environments" are industrial atmospheres with normal exposure to moderate humidity and condensation, occasional mold and mildew development, and infrequent cleaning with strong chemicals. Environments with low levels of mild chemical fumes and occasional splashing and spilling of chemical products are mild environments. Normal outdoor weathering is also considered a mild environment.

1.4 SUBMITTALS:

A. Product Data: For each coating system indicated. Include block fillers and primers.

1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference the specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each material specified.

B. Certification by manufacturer that products supplied comply with requirements indicated that limit the amount of VOCs in coating products.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated.

1. After color selection, Engineer will furnish color chips for surfaces to be coated.

D. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative samples of the actual substrate.

1. Provide stepped Samples defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
2. List of material and application for each coat of each sample. Label each sample for location and application.
3. Submit samples on the following substrates for Engineer's review of color and texture:
   a. Ferrous and Nonferrous Metal: Provide two 4-inch- square samples of flat metal and two 8-inch- long samples of solid metal for each color and finish.

E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Engineers and owners, and other information specified.

1.5 QUALITY ASSURANCE:

A. Applicator Qualifications: Engage an experienced applicator who has completed high-performance coating system applications similar in material and extent to those indicated for Project and whose work has a record of successful in-service performance.

B. Source Limitations: Obtain primers and undercoat materials for each coating system from the same manufacturer as the finish coats.

C. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample of each type of coating and substrate required. Comply with procedures specified in PDCA P5. Duplicate finish of approved sample Submittals.

1. Engineer will select one room, area, or surface to represent surfaces and conditions for application of each type of coating and substrate.

a. Wall Surfaces: Provide samples on at least 100 sq. ft. (9 sq. m) of wall surface.
b. Small Areas and Items: Engineer will designate items or areas required.

2. After permanent lighting and other environmental services have been activated, apply coatings in this room or to each surface as specified. Provide the required sheen, color, and texture of each surface.

a. After finishes are accepted, Engineer will use the room or surface to evaluate coating systems of a similar nature.

3. Final approval of colors will be from benchmark samples.

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label with the following information:

1. Name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. Handling instructions and precautions.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.

1. Protect materials from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and applying coatings.

1.7 PROJECT CONDITIONS:

A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 45 and 95 deg F (7 and 35 deg C).

B. Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1. Allow wet surfaces to dry thoroughly and attain temperature and conditions specified before proceeding with or continuing coating operation.
2. Work may continue during inclement weather only if areas and surfaces to be coated are enclosed and temperature within the area can be maintained within limits specified by manufacturer during application and drying periods.

1.8 EXTRA MATERIALS:

A. Furnish extra high-performance coating materials from the same production run as materials applied and in quantities described below. Package coating materials in unopened, factory-sealed containers for storage and identify with labels describing contents.

1. Quantity: Furnish extra coating materials in quantities indicated below:

a. High-Gloss, Aliphatic Polyurethane Enamel: One case of each color applied.
b. Semigloss, Aliphatic Polyurethane Enamel: 2 gal. (7.57 L) of each color applied.
c. High-Gloss, Waterborne, Acrylic Enamel: One case of each color applied.
d. Semigloss, Waterborne, Acrylic Enamel: 1 gal. (3.785 L) of each color applied.
e. High-Gloss, Polyamide Epoxy Coatings: One case of each color applied.
f. Semigloss, Polyamide Epoxy Coatings: One case of each color applied.

2. Quantity: Furnish an additional 5 percent, but not less than 1 gal. (3.785 L) or 1 case, as appropriate, of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products indicated in the coating system descriptions.

B. Manufacturers' Names: The following manufacturers are referred to in the coating system descriptions by shortened versions of their names shown in parenthesis:

1. Carboline Company (Carboline).
2. DuPont Company, High Performance Coatings (DuPont).
3. ICI Dulux Paints; Devoe Coatings (ICI).
4. Moore: Benjamin Moore & Co. (Moore).
5. Pittsburgh Paint; PPG Industries, Inc. (PPG).
6. Rust-Oleum Corporation (R-O).
7. Sherwin Williams; Industrial and Marine Coatings (S-W).
8. Tnemec Company, Inc. (Tnemec).

2.2 COATINGS MATERIALS, GENERAL:

A. Material Compatibility: Provide primers, undercoats, and finish-coat materials that are compatible with one another and substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's highest grade of the various high-performance coatings specified. Materials not displaying manufacturer's product identification are not acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

C. VOC Classification: Provide high-performance coating materials, including primers, undercoats, and finish-coat materials, that have a VOC classification of 450 g/L or less.

2.3 COATING FINISHED COLOR:

A. The following color coding scheme shall be used on proposed piping. Existing piping shall not be stripped and recoated unless authorized by owner or Engineer, in which case, the new coating shall follow the color coding table below, according to Ten State Standards 2014 unless otherwise noted::

1. Raw Sludge Line – Gray
2. Sludge recirculation suction line - brown with yellow bands
3. Sludge draw off line - brown with orange bands
4. Sludge recirculation discharge line - brown
5. Digested sludge line - black Sludge gas line - red
6. Natural gas line - red
7. Nonpotable water line - purple
8. Potable water line - blue
9. Fire main - red
10. Chlorine line - yellow
11. Sulfur Dioxide - yellow with red bands
12. Sewage (wastewater) line - gray
13. Compressed air line - dark green
14. Process air line - light green
15. Water lines for heating digesters or buildings - blue with a 6-inch (150 mm) red band spaced 30 inches (760 mm) apart
16. Fuel oil/diesel - red
17. Plumbing drains and vents - black
18. Ferric Chloride - orange Polymer - unpainted PVC

B. Existing piping shall not be stripped and recoated unless authorized by owner or Engineer, in which case, the new coating shall follow the color coding below:

2.4 COATING MATERIALS:

A. Ferrous Metal: Provide the following finish systems over exterior ferrous-metal surfaces. Finished colors shall not conflict with color coding specified above:

1. Severe Environment (Semigloss Finish): One finish coat over an intermediate coat and a primer.

a. Primer: Epoxy primer applied at spreading rate recommended by manufacturer.
1) Moore: M36-00/M37 Polyamide Epoxy Clear Sealer/Finish.

2) PPG: 97-14XX Series Pitt-Guard DTR Polyamide Epoxy Coating.
3) S-W: Recoatable Epoxy Primer B67 Series/B67V5.
4) Tnemec: Series 27 F. C. Typoxy Polyamide Epoxy.

b. Intermediate Coat: Epoxy applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 3.0 to 5.0 mils (0.076 to 0.127 mm).
1) S-W: Heavy Duty Epoxy B67W300 Series.
2) Tnemec: Series 66 Hi-Build Epoxoline.

c. Intermediate Coat: Aliphatic polyurethane enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 1.5 to 4.0 mils (0.038 to 0.102 mm).

1) ICI: Devthane 378 Aliphatic Urethane Semi-Gloss Enamel.
2) Moore: M73/M75 Aliphatic Acrylic Urethane Semi-Gloss.
3) PPG: 97-84XX Series Pitthane High Build Acrylic-Aliphatic Urethane Enamel.

d. Topcoat: Aliphatic polyurethane enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 1.5 to 4.0 mils.
1) ICI: Devthane 378 Aliphatic Urethane Semi-Gloss Enamel.
2) Moore: M73/M75 Aliphatic Acrylic Urethane Semi-Gloss.
3) PPG: 97-84XX Series Pitthane High Build Acrylic-Aliphatic Urethane Enamel.
4) S-W: Corothane II Satin B65W200 Series.
5) Tnemec: Series 75 Endura-Shield.

2. Moderate Environment (Semigloss Finish): One finish coat over an intermediate coat and a primer.

a. Primer: Epoxy primer applied at spreading rate recommended by manufacturer.
1) ICI: Devran 224HS High Build Epoxy.
2) Moore: M36-00/M37 Polyamide Epoxy Clear Sealer/Finish.
3) PPG: 97-14XX Series Pitt-Guard DTR Polyamide Epoxy Coating.
4) S-W: Recoatable Epoxy Primer B67 Series/B67V5.
5) Tnemec: Series 27 F. C. Typoxy Polyamide Epoxy.

b. Intermediate Coat: Epoxy applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 3.0 to 8.0 mils.
1) S-W: Heavy Duty Epoxy B67W300 Series.
2) Tnemec: Series 66 Hi-Build Epoxoline Polamidoamine Epoxy.

c. Intermediate Coat: Aliphatic polyurethane enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 1.5 to 4.0 mils.
1) Moore: M73/M75 Aliphatic Acrylic Urethane Semi-Gloss.
2) PPG: 97-84XX Series Pitthane High Build Acrylic-Aliphatic Urethane Enamel.

d. Topcoat: Aliphatic polyurethane enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 1.5 to 4.0 mils.
1) Moore: M73/M75 Aliphatic Acrylic Urethane Semi-Gloss.
2) PPG: 97-84XX Series Pitthane High Build Acrylic-Aliphatic Urethane Enamel.

3) S-W: Corothane II Satin B65W200 Series.
4) Tnemec: Series 75 Endura-Shield.

3. Mild Environment (Semigloss Finish): One finish coat over an intermediate coat and a primer.

a. Primer: Acrylic primer applied at spreading rate recommended by manufacturer.
1) ICI: Devflex 4020 DTM Flat Waterborne Primer and Finish.
2) Moore: M04 Acrylic Primer.
3) PPG: 90-7XX Series Pitt-Tech One Pack Interior/Exterior Primer Finish DTM Industrial Enamel.
4) S-W: Kem Kromik Universal Metal Primer B50Z Series.
5) Tnemec: Series 18 Enviroprime.

b. Intermediate Coat: Semigloss acrylic enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 1.5 to 4.0 mils.
1) International: Intercryl 520 WB Waterborne Acrylic Semi-Gloss Finish.
2) Moore: M29 D.T.M. Acrylic Semi-Gloss.
3) PPG: 90-4XX Series Pitt-Tech One Pack Interior/Exterior High Performance Waterborne Satin DTM Industrial Enamels.
4) S-W: DTM Acrylic Semi-Gloss Coating B66W200 Series.
5) Tnemec: Series 29 Tufcryl Acrylic Emulsion.

c. Topcoat: Semigloss acrylic enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 1.5 to 4.0 mils.
1)
2) Moore: M29 D.T.M. Acrylic Semi-Gloss.
3) PPG: Pitt-Tech One Pack Interior/Exterior 90-4XX Series High Performance Waterborne Satin DTM Industrial Enamels.
4) S-W: DTM Acrylic Semi-Gloss Coating B66W200 Series.
5) Tnemec: Series 29 Tufcryl Acrylic Emulsion.

4. Moderate Environment (High-Gloss Finish): One finish coat over an intermediate coat and a primer.

a. Primer: Epoxy primer applied at spreading rate recommended by manufacturer.
1) Moore: M43-00/M44-84 Acrylic Epoxy Clear Gloss Coating.
2) PPG: 97-14XX Series Pitt-Guard DTR Epoxy.
3) R-O: 9100 System Labor Saver High Performance Epoxy.
4) S-W: Heavy Duty Epoxy B67W300 Series/B60V3.
5) Tnemec: Series 84 H. S. Epoxy.

b. Intermediate Coat: Epoxy applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 2.0 to 5.0 mils.
1) Moore: M43/M44 Acrylic Epoxy Gloss Coating.
2) PPG: 97-1XXX Series Aquapon Polyamide-Epoxy Coating.
3) S-W: Tile Clad II High Solids B62WZ Series B60VZ70.
4) Tnemec: Intermediate coat not required.

c. Topcoat: High-gloss epoxy applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 2.0 to 5.0 mils.
1) Moore: M43/M44 Acrylic Epoxy Gloss Coating.
2) PPG: 97-1XXX Series Aquapon Polyamide-Epoxy Coating.

3) S-W: Tile Clad II High Solids B62WZ Series B60VZ70.
4) Tnemec: Series 84 H. S. Epoxy.

5. Moderate Environment (Semigloss Finish): One finish coat over an intermediate coat and a primer.

a. Primer: Epoxy primer applied at spreading rate recommended by manufacturer.
1) PPG: 97-14XX Series Pitt-Guard DTR Polyamide Epoxy Coating.
2) S-W: Recoatable Epoxy Primer B67 Series/B67V5.
3) Tnemec: Series 27 F. C. Typoxy Polyamide Epoxy.

b. Intermediate Coat: Epoxy applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 2.0 to 5.0 mils.
1) PPG: 97-1XXX Series Aquapon High Build Semi-Gloss Polyamide Epoxy Coating.
2) S-W: Epolon II Multi-Mil Epoxy Series B62V800.
3) Tnemec: Series 66 Hi-Build Epoxoline.

c. Topcoat: Semigloss epoxy applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 2.0 to 5.0 mils unless otherwise indicated.
1) PPG: 97-1XXX Series Aquapon High Build Semi-Gloss Polyamide Epoxy Coating.
2) S-W: Epolon II Multi-Mil Epoxy Series B62V800.
3) Tnemec: Series 66 Hi-Build Epoxoline.

6. Mild Environment (Semigloss Finish): One finish coat over an intermediate coat and a primer.

a. Primer: Acrylic or epoxy primer, as recommended by manufacturer for this substrate, applied at spreading rate recommended by manufacturer.
1) Moore: M04 Acrylic Metal Primer.
2) PPG: 90-7XX Series Pitt-Tech One Pack Interior/Exterior Primer Finish DTM Industrial Enamel.
3) S-W: Kem Kromik Universal Metal Primer B50Z Series.
4) Tnemec: Series 18 Enviroprime.

b. Intermediate Coat: Acrylic enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 1.0 to 4.0 mils.
1) Moore: M29 D.T.M. Acrylic Semi-Gloss Finish.
2) PPG: 90-4XX Series Pitt-Tech One Pack Interior/Exterior High Performance Waterborne Satin DTM Industrial Enamel.
3) S-W: DTM Acrylic Semi-Gloss Coating B66W200 Series.
4) Tnemec: Series 29 Tuf-Cryl Water Based Acrylic Emulsion.

c. Topcoat: Semigloss acrylic enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 1.0 to 4.0 mils.
1) Moore: M29 D.T.M. Acrylic Semi-Gloss Finish.
2) PPG: 90-4XX Series Pitt-Tech One Pack Interior/Exterior High Performance Waterborne Satin DTM Industrial Enamel.
3) S-W: DTM Acrylic Semi-Gloss Coating B66W200 Series.
4) Tnemec: Series 29 Tuf-Cryl Water Based Acrylic Emulsion.

B. Nonferrous Metal: Provide the following finish systems over interior nonferrous-metal surfaces. Finished colors shall not conflict with color coding specified above:

1. Severe Environment (Semigloss Finish): One finish coat over an intermediate coat and a primer.

   a. Primer: Acrylic or epoxy primer, as recommended by manufacturer for this substrate, applied at spreading rate recommended by manufacturer.
      1) PPG: 97-14XX Series Pitt-Guard DTR Epoxy.
      2) S-W: DTM Wash Primer B71Y1.
      3) Tnemec: Series 27 F. C. Typoxy Polyamide Epoxy.

   b. Intermediate Coat: Epoxy applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 2.0 to 5.0 mils.
      1) PPG: 97-1XXX Series Aquapon High Build Semi-Gloss Polyamide Epoxy Coating.
      2) S-W: Epolon II Multi-Mil Epoxy Series B62V800.
      3) Tnemec: Intermediate coat not required.

   c. Topcoat: Semigloss epoxy applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 2.0 to 5.0 mils, unless otherwise indicated.
      1) PPG: 97-1XXX Series Aquapon High Build Semi-Gloss Polyamide Epoxy Coating.
      2) S-W: Epolon II Multi-Mil Epoxy Series B62V800.
      3) Tnemec: Series 66 Hi-Build Epoxoline.

2. Moderate Environment (Semigloss Finish): One finish coat over an intermediate coat and a primer.

   a. Primer: Acrylic or epoxy primer, as recommended by manufacturer for this substrate, applied at spreading rate recommended by manufacturer.
      1) PPG: 97-14XX Series Pitt-Guard DTR Epoxy.
      2) S-W: DTM Wash Primer B71Y1.
      3) Tnemec: Series 27 F. C. Typoxy Polyamide Epoxy.

   b. Intermediate Coat: Epoxy applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 2.0 to 5.0 mils.
      1) PPG: 97-1XXX Series Aquapon High Build Semi-Gloss Polyamide Epoxy Coating.
      2) S-W: Epolon II Multi-Mil Epoxy Series B62V800.
      3) Tnemec: Intermediate coat not required.

   c. Topcoat: Semigloss epoxy applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 2.0 to 5.0 mils, unless otherwise indicated.
      1) PPG: 97-1XXX Series Aquapon High Build Semi-Gloss Polyamide Epoxy Coating.
      2) S-W: Epolon II Multi-Mil Epoxy Series B62V800.
      3) Tnemec: Series 66 Hi-Build Epoxoline.

3. Mild Environment (Semigloss Finish): One finish coat over an intermediate coat and a primer.

a. Primer: Acrylic or epoxy primer, as recommended by manufacturer for this substrate, applied at spreading rate recommended by manufacturer.
   1) Moore: M15 Bonding Primer.
   2) PPG: 90-7XX Series Pitt-Tech One Pack Interior/Exterior Primer Finish DTM Industrial Enamel.
   3) S-W: DTM Wash Primer B71Y1.
   4) Tnemec: Series 27 F. C. Typoxy Polyamide Epoxy.

b. Intermediate Coat: Acrylic enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 1.5 to 4.0 mils.
   1) Moore: M29 D.T.M. Acrylic Semi-Gloss Finish.
   2) PPG: 90-4XX Series Pitt-Tech One Pack Interior/Exterior High Performance Waterborne Satin DTM Industrial Enamel.
   3) S-W: DTM Acrylic Semi-Gloss Coating B66W200 Series.
   4) Tnemec: Intermediate coat not required.

c. Topcoat: Semigloss acrylic enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 1.5 to 4.0 mils.
   1) Moore: M29 D.T.M. Acrylic Semi-Gloss Finish.
   2) PPG: 90-4XX Series Pitt-Tech One Pack Interior/Exterior High Performance Waterborne Satin DTM Industrial Enamel.
   3) S-W: DTM Acrylic Semi-Gloss Coating B66W200 Series.
   4) Tnemec: Series 29 Tuf-Cryl Water Based Acrylic Emulsion.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. With Applicator present, examine substrates and conditions under which high-performance coatings will be applied, for compliance with coating application requirements.

   1. Apply coatings only after unsatisfactory conditions have been corrected and surfaces to receive coatings are thoroughly dry.
   2. Start of application is construed as Applicator's acceptance of surfaces within that particular area.

B. Coordination of Work: Review other Sections in which primers or other coatings are provided to ensure compatibility of total systems for various substrates. On request, furnish information on characteristics of specified finish materials to ensure compatible primers.

   1. If a potential incompatibility of primers applied by others exists, obtain the following from the primer Applicator before proceeding:

      a. Confirmation of primer's suitability for expected service conditions.
      b. Confirmation of primer's ability to be top coated with materials specified.

   2. Notify Engineer about anticipated problems before using the coatings specified over substrates primed by others.

3.2 PREPARATION:

A. General: Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.

1. After completing coating operations, reinstall items that were removed; use workers skilled in the trades involved.

B. Cleaning: Before applying high-performance coatings, clean substrates of substances that could impair bond of coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and coating application so dust and other contaminates from cleaning process will not fall on wet, newly coated surfaces.

C. Surface Preparation: Clean and prepare surfaces to be coated according to manufacturer's written instructions for each substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove primers and reprime substrate.
2. Cementitious Substrates: Prepare concrete, brick, concrete masonry block, and cement plaster surfaces to be coated. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods to prepare surfaces.

a. Use abrasive blast-cleaning methods if recommended by coating manufacturer.
b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not coat surfaces if moisture content exceeds that permitted in manufacturer's written instructions.

3. Ferrous-Metal Substrates: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC recommendations.

a. Blast-clean steel surfaces as recommended by coating manufacturer and according to SSPC-SP 10/NACE No. 2.
b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire brush, solvent clean, and touch up with same primer as the shop coat.

4. Nonferrous-Metal Substrates: Clean nonferrous and galvanized surfaces according to manufacturer's written instructions for the type of service, metal substrate, and application required.

a. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

D. Material Preparation: Carefully mix and prepare coating materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying coatings in a clean condition, free of foreign materials and residue.

2. Stir materials before applying to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into the material. Remove film and, if necessary, strain coating material before using.
3. Use only the type of thinners approved by manufacturer and only within recommended limits.

E. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION:

A. General: Apply high-performance coatings according to manufacturer's written instructions.

1. Use applicators and techniques best suited for the material being applied.
2. Do not apply high-performance coatings over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to forming a durable coating film.
3. Coating colors, surface treatments, and finishes are indicated in the coating system descriptions.
4. Provide finish coats compatible with primers used.
5. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, grilles, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.

    a. Coat surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
    b. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

6. All interior piping shall be painted in accordance with section 54.5 of “Ten States Recommended Standards for Wastewater Facilities”.

B. Scheduling Coating: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for coating as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and film thickness required is the same regardless of application method.

    a. Omit primer on metal surfaces that have been shop primed and touchup painted.
    b. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer.
    c. Where manufacturer's written instructions require sanding, sand between applications to produce a smooth, even surface.
    d. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until coating has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat does not cause undercoat to lift or lose adhesion.

2. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance. Give special attention to

edges, corners, crevices, welds, exposed fasteners, and similar surfaces to ensure that they receive a dry film thickness equivalent to that of flat surfaces.

C. Application Procedures: Apply coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

1. Brush Application: Use brushes best suited for material applied and of appropriate size for the surface or item being coated.

   a. Apply primers and first coats by brush unless manufacturer's written instructions permit using roller or mechanical applicators.
   b. Brush out and work brush coats into surfaces in an even film.
   c. Eliminate cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Neatly draw glass lines and color breaks.

2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by manufacturer for the material and texture required.
3. Spray Equipment: Use mechanical methods to apply coating if permitted by manufacturer's written instructions and governing regulations.

   a. Use spray equipment with orifice size recommended by manufacturer for material and texture required.
   b. Apply each coat to provide the equivalent hiding of brush-applied coats.
   c. Do not double back with spray equipment building-up film thickness of two coats in one pass, unless recommended by manufacturer.

D. Minimum Coating Thickness: Apply each material no thinner than manufacturer's recommended spreading rate. Provide total dry film thickness of the entire system as recommended by manufacturer.

E. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

F. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by manufacturer, to material required to be coated or finished that has not been prime coated by others.

1. Recoat primed and sealed substrates if there is evidence of suction spots or unsealed areas in first coat, to ensure a finish coat with no burn-through or other defects caused by insufficient sealing.

G. Completed Work: Match approved Samples for color, texture, and coverage. Remove, refinish, or recoat work that does not comply with specified requirements.

3.4 SCHEDULE:

A. The following schedule shall be used to classify environment by location:

Location	Classification
Bulk Storage Room	Severe

Mudwells	Severe
Clearwells	Severe
All other treatment building areas	Moderate
Well Houses	Moderate

3.5 FIELD QUALITY CONTROL:

A. Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when coatings are being applied:

1. Owner will engage the services of a qualified testing agency to sample coating material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will perform appropriate tests for the following characteristics as required by Owner:

a. Quantitative materials analysis.
b. Absorption.
c. Accelerated weathering.
d. Accelerated yellowness.
e. Color retention.
f. Alkali and mildew resistance.
g. Abrasion resistance.
h. Apparent reflectivity.
i. Washability.
j. Dry opacity.
k. Recoating.
l. Skinning.

3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with specified requirements. Contractor shall remove noncomplying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. If necessary, Contractor may be required to remove rejected materials from previously coated surfaces if, on recoating with specified materials, the two coatings are not compatible.

3.6 CLEANING:

A. Cleanup: At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

1. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

3.7 PROTECTION:

A. Protect work of other trades, whether being coated or not, against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Engineer, and leave in an undamaged condition.

1. Provide "Wet Paint" signs to protect newly coated finishes. After completing coating operations, remove temporary protective wrappings provided by others to protect their work.
2. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces. Comply with procedures specified in PDCA P1.

END OF SECTION 099600

SECTION 101423.16 - ROOM-IDENTIFICATION PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes room-identification signs that are directly attached to the building.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For room-identification signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in ICC A117.1, included but not limited to raised characters, braille, character height, contrasting colors, and sign location.

2.2 ROOM-IDENTIFICATION SIGNS

A. Room-Identification Sign: Sign system with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Best Sign Systems, Inc.
    b. Inpro Corporation.
    c. Vista System.

2. Laminated-Sheet Sign: Sandblasted polymer face sheet with raised graphics laminated to acrylic backing sheet to produce composite sheet.

    a. Composite-Sheet Thickness: 0.125 inch.
    b. Surface-Applied Graphics: Applied paint.
    c. Color(s): As selected by Engineer/Architect from manufacturer's full range.

3. Sign-Panel Perimeter: Finish edges smooth.

    a. Edge Condition: Square cut.
    b. Corner Condition in Elevation: Square.

4. Mounting: Surface mounted to wall with two-face tape.

2.3 SIGN MATERIALS

A. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

B. Vinyl Film: UV-resistant vinyl film with pressure-sensitive, permanent adhesive; die cut to form characters or images as indicated on Drawings and suitable for exterior applications.

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
3. Exposed Metal-Fastener Components, General:

    a. Fabricated from same basic metal and finish of fastened sign unless otherwise indicated.

4. Sign Mounting Fasteners:

a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.
b. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.

B. Adhesive: As recommended by sign manufacturer.

C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
2. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
3. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

B. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.

C. Subsurface-Etched Graphics: Reverse etch back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

B. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface,

embedding studs in holes. Temporarily support sign in position until adhesive fully sets.

b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
3. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
4. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

3.2 SCHEDULE

DESCRIPTION	**QTY**
MEN'S TOILET ROOM	3
WOMEN'S TOILET ROOM	3
OFFICE	3
EXIT	18
RESTROOMS	2
ENTRY	3

25 ADDITIONAL ROOM IDENTIFICATION SIGNS SHALL BE INCLUDED. ROOM NAMES TO BE PROVIDED LATER.

END OF SECTION 101423.16

SECTION 102113.19 - PLASTIC TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-plastic toilet compartments configured as toilet enclosures entrance screens and urinal screens.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for supports that attach floor-and-ceiling-anchored compartments and post-to-ceiling screens to overhead structural system.
2. Section 061000 "Rough Carpentry" for blocking, overhead support of floor-and-ceiling-anchored compartments and overhead support of post-to-ceiling screens.
3. Section 102800 "Toilet, Bath, and Laundry Accessories" for accessories mounted on toilet compartments.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Solid-plastic toilet compartments:

B. Shop Drawings: For solid-plastic toilet compartments.

1. Include plans, elevations, sections, details, and attachment details.

C. Samples: For each type of toilet compartment material indicated.

1. Include Samples of hardware and accessories involving material and color selection.

1.3 INFORMATIONAL SUBMITTALS

A. Certificates:

1. Product Certificates: For each type of toilet compartment by manufacturer.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire Performance: Tested in accordance with, and pass the acceptance criteria of, NFPA 286.

B. Regulatory Requirements: Comply with applicable provisions in ICC A117.1 for toilet compartments designated as accessible.

2.2 SOLID-PLASTIC TOILET COMPARTMENTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. General Partitions Mfg. Corp.
   2. Global Partitions Corp., an ASI Group Company.
   3. Scranton Products.

B. Toilet-Enclosure Style: Overhead braced Floor anchored.

C. Entrance-Screen Style: Overhead braced Floor anchored.

D. Urinal-Screen Style: Wall hung.

E. Door, Panel, Screen, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch thick, seamless, with eased edges, no-sightline system, and with homogenous color and pattern throughout thickness of material.

   1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
   2. Heat-Sink Strip: Manufacturer's standard continuous, extruded-aluminum or stainless steel strip fastened to exposed bottom edges of solid-plastic components to hinder malicious combustion.
   3. Color and Pattern: One color and pattern in each room as selected by Engineer/Architect from manufacturer's full range.

F. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; polymer or stainless steel.

   1. Polymer Color and Pattern: Matching pilaster.

G. Brackets (Fittings):

   1. Stirrup Type: Ear or U-brackets, stainless steel.
   2. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

      a. Polymer Color and Pattern: Matching panel.

2.3 HARDWARE AND ACCESSORIES

A. Hardware and Accessories, Heavy Duty: Manufacturer's heavy-duty operating hardware and accessories.

1. Hinges: Manufacturer's minimum 0.062-inch-thick stainless steel paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees, allowing emergency access by lifting door. Mount with through bolts.
2. Latch and Keeper: Manufacturer's heavy-duty, surface-mounted, cast-stainless steel latch unit, designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through bolts.
3. Coat Hook: Manufacturer's heavy-duty combination cast-stainless steel hook and rubber-tipped bumper, sized to prevent inswinging door from hitting compartment-mounted accessories. Mount with through bolts.
4. Door Bumper: Manufacturer's heavy-duty, rubber-tipped, cast-stainless steel bumper at outswinging doors and entrance-screen doors. Mount with through bolts.
5. Door Pull: Manufacturer's heavy-duty, cast-stainless steel pull at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through bolts.

2.4 MATERIALS

A. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.

B. Stainless Steel Castings: ASTM A743/A743M.

2.5 FABRICATION

A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

C. Floor-and-Ceiling-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

D. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of posts. Provide shoes and sleeves (caps) at posts to conceal anchorage.

E. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide, inswinging doors for standard toilet compartments and 36-inch-wide, outswinging doors with a minimum 32-inch-wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION OF PLASTIC TOILET COMPARTMENTS

A. General: Comply with manufacturer's written installation instructions. Install units straight, rigid, level & plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

a. Pilasters and Panels: 1/2 inch.
b. Panels and Walls: 1 inch.

2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.

a. Locate wall brackets, so holes for wall anchors occur in masonry or tile joints.
b. Align brackets at pilasters with brackets at walls.

3. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.

a. Locate bracket fasteners, so holes for wall anchors occur in masonry or tile joints.
b. Align brackets at pilasters with brackets at walls.

B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels and adjust, so tops of doors are parallel with overhead brace when doors are in closed position.

C. Floor-and-Ceiling-Anchored Units: Secure pilasters to supporting construction and level, plumb, and tighten. Hang doors and adjust, so doors are level and aligned with panels, when doors are in closed position.

D. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on inswinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on outswinging doors and doors in entrance screens to return doors to fully closed position.

END OF SECTION 102113.19

SECTION 102123 - CUBICLE CURTAINS AND TRACK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cubicle-curtain tracks and carriers.
2. Cubicle curtains.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Cubicle Curtains: Provide curtain fabrics with the following characteristics:

1. Laundering: Launderable to a water temperature of not less than 160 deg F.
2. Flame Resistance: Provide fabrics identical to those that have passed NFPA 701 when tested by a qualified testing agency acceptable to authorities having jurisdiction.

a. Identify fabrics with appropriate markings of a qualified testing agency.

2.2 CUBICLE-CURTAIN SUPPORT SYSTEMS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Construction Specialties, Inc.
2. Inpro Corporation.

B. Extruded-Aluminum Curtain Track: Not less than 5/8 inch wide by 1/2 inch high.

1. Curved Track: Factory-fabricated, 12-inch- radius bends.
2. Finish: Baked enamel, acrylic, or epoxy.

C. PVC Curtain Track: Not less than 1-1/4 inches wide by 15/16 inch high.

1. Curved Track: Factory-fabricated, 12-inch-radius bends.

D. Curtain Track Accessories: Fabricate splices, end caps, connectors, end stops, coupling and joining sleeves, wall flanges, brackets, ceiling clips, and other accessories from same material and with same finish as track.

1. End Stop: Removable with carrier hook.

E. Curtain Glide Carriers: One-piece nylon glide with chrome-plated steel hook.

F. Breakaway Curtain Carriers: One-piece nylon breakaway curtain carriers designed to allow curtains to detach from tracks with a pulling force of no more than 5 lbf.

G. Exposed Fasteners: Stainless steel.

H. Concealed Fasteners: Stainless steel.

2.3 CURTAINS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Inpro Corporation.

B. Fabric: Curtain manufacturer's standard, 100 percent polyester; inherently and permanently flame resistant, stain resistant, and antimicrobial.

1. Proprietary Fiber:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) INVISTA.
2) Trevira.

2. Pattern: Clikeze Super Bio Stat vinyl
3. Width: 5’-0”.
4. Color: As selected by Architect from manufacturer's full range.

C. Curtain Grommets: Two-piece, rolled-edge, rustproof, nickel-plated brass; spaced not more than 6 inches o.c.; machined into top hem.

D. Mesh Top: Not less than 20-inch- high mesh top.

1. Mesh: No. 50 nylon mesh.

E. Beaded-Chain Curtain Drop: 18 inches long; nickel-plated steel with aluminum hook.

F. Snap Attachments: Provide manufacturer's standard nickel-plated brass snap attachments for modular panels.

G. Curtain Tieback: Nickel-plated brass chain; one at each curtain termination.

2.4 CURTAIN FABRICATION

A. Continuous Curtain Panels:

1. Width: Equal to track length from which curtain is hung plus 10 percent of added fullness, but not less than 12 inches of added fullness.
2. Length: Equal to floor-to-ceiling height, minus depth of track and carrier at top, and minus clearance above the finished floor of 12 inches.

B. Modular Curtain Panels:

1. Fabric Panels: 48 inches wide. Fabricate panels in quantity required to provide assembled curtains equal to track lengths plus 10 percent added fullness, but not less than 12 inches added fullness.
2. Length: Equal to floor-to-ceiling height, minus depth of track and carrier at top, and minus clearance above the finished floor of 12 inches.
3. Mesh Top: Modular, matching width of modular fabric panels with snap attachments at side hems of mesh-top panels.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install tracks level and plumb, according to manufacturer's written instructions.

B. For tracks of up to 20 feet in length, provide track fabricated from single, continuous length.

1. Curtain-Track Mounting: Surface.

C. Track Accessories: Install splices, end caps, connectors, end stops, coupling and joining sleeves, and other accessories as required for a secure and operational installation.

1. Provide one hinged loading unit for each bed.

D. Curtain Carriers: Provide curtain carriers adequate for 6-inch spacing along full length of curtain plus an additional carrier.

E. Cubicle Curtains: Hang curtains on each curtain track. Secure with curtain tieback.

END OF SECTION 102123

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Public-use shower room accessories.
3. Private-use bathroom accessories.
4. Childcare accessories.
5. Underlavatory guards.
6. Custodial accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: Full size, for each exposed product and for each finish specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

A. Toilet Tissue (Roll) Dispenser:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. AJW Architectural Products.
    b. Bobrick Washroom Equipment, Inc.
    c. Bradley Corporation.

2. Description: Double-roll dispenser.
3. Mounting: Surface mounted.
4. Operation: Noncontrol delivery with theft-resistant spindle.
5. Capacity: Designed for 5-inch- diameter tissue rolls.
6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

B. Liquid-Soap Dispenser:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. AJW Architectural Products.
    b. Bobrick Washroom Equipment, Inc.
    c. Bradley Corporation.

2. Description: Designed for dispensing hands free antibacterial soap in lather form.
3. Mounting: Vertically oriented, surface mounted.
4. Capacity: 40 oz.
5. Lockset: Tumbler type.
6. Refill Indicator: Window type.

C. Grab Bar:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. AJW Architectural Products.
    b. Bobrick Washroom Equipment, Inc.
    c. Bradley Corporation.

2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.

    a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin) on ends and slip-resistant texture in grip area.

4. Outside Diameter: 1-1/2 inches.

5. Configuration and Length: As indicated on Drawings.

D. Sanitary-Napkin Disposal Unit:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. AJW Architectural Products.
    b. Bobrick Washroom Equipment, Inc.
    c. Bradley Corporation.

2. Mounting: Surface mounted.
3. Door or Cover: Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.
4. Receptacle: Removable.
5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

E. Mirror Unit:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. AJW Architectural Products.
    b. Bobrick Washroom Equipment, Inc.
    c. Bradley Corporation.

2. Frame: Stainless steel angle, 0.05 inch thick.

    a. Corners: Welded and ground smooth.

3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.

    a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
    b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.

4. Size: As indicated on Drawings.

F. Coat Hook:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. AJW Architectural Products.
    b. Bobrick Washroom Equipment, Inc.

c. Bradley Corporation.

2. Description: Single-prong unit.
3. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

2.3 PRIVATE-USE BATHROOM ACCESSORIES

A. Toilet Tissue Dispenser:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. AJW Architectural Products.
   b. Bobrick Washroom Equipment, Inc.
   c. Bradley Corporation.

2. Description: Double-roll dispenser with hood.
3. Mounting: Surface mounted.
4. Capacity: Designed for 4-1/2- or 5-inch-diameter tissue rolls.
5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

B. Robe Hook:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. AJW Architectural Products.
   b. Bobrick Washroom Equipment, Inc.
   c. Bradley Corporation.

2. Description: Single-prong unit.
3. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

C. Paper Towel (Roll) Dispenser:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. AJW Architectural Products.
   b. Bobrick Washroom Equipment, Inc.
   c. Bradley Corporation.

2. Description: Unit for dispensing preset length of roll paper towels.
3. Mounting: Wall mounted.
4. Minimum Towel-Dispenser Capacity: 8-inch-wide, 800-foot-long roll.
5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
6. Lockset: Tumbler type for towel dispenser compartment.

2.4 CHILDCARE ACCESSORIES

A. Diaper-Changing Station:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Bradley Corporation.
    b. GAMCO Specialty Accessories; a division of Bobrick.
    c. Koala Kare Products; a Division of Bobrick.

2. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap. Basis of Design is Bradley Model 9632.

    a. Engineered to support minimum of 250-lb static load when opened.

3. Mounting: Surface mounted, with unit projecting not more than 4 inches from wall when closed.
4. Operation: By pneumatic shock-absorbing mechanism.
5. Material and Finish: HDPE in manufacturer's standard color.
6. Liner Dispenser: Built in.

2.5 UNDERLAVATORY GUARDS

A. Underlavatory Guard:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Buckaroos, Inc.
    b. Plumberex Specialty Products, Inc.
    c. Truebro by IPS Corporation.

2. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
3. Material and Finish: Antimicrobial, molded plastic, white.

2.6 WARM-AIR DRYERS

A. High-Speed Warm-Air Dryer:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Excel Dryer, Inc.
    b. Bobrick Washroom Equipment, Inc.

c. Bradley Corporation.

B. Basis of Design: XLERATOReco Hand dryer

1. Description: High-speed, adjustable velocity, warm-air hand dryer for rapid hand drying, with adjustable velocity.
2. Mounting: Surface mounted, with low-profile design.
3. Operation: Electronic-sensor activated with operation time of 8 to 20 seconds.
4. Cover Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
5. Electrical Requirements: 110 V, 13 A, 1500 W.
6. Filter Requirements: HEPA filtration
7. Sound Level Requirements: Noise Reduction Nozzle
8. ADA compliance features: to include recess kit (Excel #40502).

2.7 CUSTODIAL ACCESSORIES

A. Utility Shelf:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. AJW Architectural Products.
b. Bobrick Washroom Equipment, Inc.
c. Bradley Corporation.

2. Description: With exposed edges turned down not less than 1/2 inch and supported by two triangular brackets welded to shelf underside.
3. Size: 16 inches long by 6 inches deep.
4. Material and Finish: Not less than nominal 0.05-inch-thick stainless steel, ASTM A480/A480M No. 4 finish (satin).

B. Mop and Broom Holder:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. AJW Architectural Products.
b. Bobrick Washroom Equipment, Inc.
c. Bradley Corporation.

2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
3. Length: 36 inches.
4. Hooks: Four.
5. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

a. Shelf: Not less than nominal 0.05-inch-thick stainless steel.
b. Rod: Approximately 1/4-inch-diameter stainless steel.

2.8 FABRICATION

A. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F446.

END OF SECTION 102800

SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for portable fire extinguishers.

1.2 PREINSTALLATION CONFERENCE

A. Preinstallation Conference: Conduct conference at a location to be determined.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For fire-protection cabinets.

C. Samples: For each type of exposed finish required.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

2.2 FIRE-PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Babcock-Davis.
    b. JL Industries, Inc.; a division of the Activar Construction Products Group.
    c. Larsens Manufacturing Company.
    d. Potter Roemer LLC; a Division of Morris Group International.

B. Cabinet Construction: Nonrated.

C. Cabinet Material: Cold-rolled steel sheet.

D. Recessed Cabinet:

1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

E. Cabinet Trim Material: Same material and finish as door.

F. Door Material: Extruded-aluminum shapes.

G. Door Style: Vertical duo panel with frame.

H. Door Glazing: Tempered float glass (clear).
1. Acrylic Sheet Color: Clear transparent acrylic sheet painted white on unexposed side.

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

J. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
3. Door Lock: Cylinder lock, keyed alike to other cabinets.
4. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.

    a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."

        1) Location: Applied to cabinet glazing.
        2) Application Process: Pressure-sensitive vinyl letters.
        3) Lettering Color: Red.

4) Orientation: Vertical.

5. Alarm: Manufacturer's standard alarm that actuates when fire-protection cabinet door is opened and that is powered by low voltage, complete with transformer.

K. Materials:

1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.

a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
b. Color: As selected by Engineer/Architect from manufacturer's full range.

2. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.3 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Prepare recesses for recessed and semi recessed fire-protection cabinets as required by type and size of cabinet and trim style.

B. Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

C. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

D. Identification: Apply vinyl lettering at locations indicated.

E. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at a location to be determined.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Babcock-Davis.
    b. Guardian Fire Equipment, Inc.
    c. JL Industries, Inc.; a division of the Activar Construction Products Group.
    d. Kidde Residential and Commercial Division.
    e. Larsens Manufacturing Company.
    f. Potter Roemer LLC; a Division of Morris Group International.

2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

B. Multipurpose Dry-Chemical Type: UL-rated 5 lbs nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Babcock-Davis.
    b. Guardian Fire Equipment, Inc.
    c. JL Industries, Inc.; a division of the Activar Construction Products Group.
    d. Kidde Residential and Commercial Division.
    e. Larsens Manufacturing Company.
    f. Potter Roemer LLC; a Division of Morris Group International.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Engineer/Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

1. Mounting Brackets: Top of fire extinguisher to be at 42 inches above finished floor.

C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

SECTION 105113 - METAL LOCKERS

1.1 SUMMARY

A. Section Includes:

1. Welded corridor lockers.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at **Project site**

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For metal lockers.

1. Include plans, elevations, sections, and attachment details.
2. Include locker identification system and numbering sequence.

C. Samples: For each color specified.

1.4 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.

1. Warranty Period for Welded Metal Lockers: **10 years** from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. lockers[**and locker benches**] indicated to be accessible, comply with applicable provisions in **ICC A117.1**

2.2 WELDED CORRIDOR LOCKERS

A. Manufacturers:

1. Penco Products, Inc.
2. Centar Industries, Inc.
3. Lyon LLC

B. Doors: One piece; fabricated from 0.075-inch nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.

1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches wide; welded to inner face of doors.
2. Door Style: **Vented panel as follows:**

a. Louvered Vents: No fewer than **six louver openings at top and bottom for single-tier**

C. Body: Assembled by welding body components together. Fabricate from unperforated steel sheet with thicknesses as follows:

1. Tops, Bottoms, and Sides: 0.060-inch nominal thickness.
2. Backs: 0.048-inch nominal thickness.
3. Shelves: 0.060-inch nominal thickness, with double bend at front and single bend at sides and back.

D. Frames: Channel formed; fabricated from 0.060-inch nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.

E. Hinges:

1. Continuous Hinges: Manufacturer's standard, steel, full height.

F. Recessed Door Handle and Latch: Stainless steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.

1. Single-Point Latching: Nonmoving latch hook **with steel padlock loop that projects through recessed cup and is finished to match metal locker body**.

a. Latch Hook: Equip each door with one latch hook.

G. Locks: **Combination padlocks**

H. Identification Plates: Manufacturer's standard, etched, embossed, or stamped **aluminum** plates, with numbers and letters at least 3/8 inch high.

I. Hooks: Manufacturer's standard ball-pointed, aluminum or steel; zinc plated.

J. Coat Rods: Manufacturer's standard.

K. Legs: 6 inches high; formed by extending vertical frame members, or fabricated from 0.075-inch nominal-thickness steel sheet; welded to bottom of locker.

1. Provide closed front and end bases.

L. Filler Panels: Fabricated from 0.048-inch nominal-thickness steel sheet.

M. Finished End Panels: Fabricated from 0.024-inch nominal-thickness steel sheet to cover unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

N. Materials:

1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.

O. Finish: Baked enamel or powder coat.

1. Color: **As selected by Architect from manufacturer's full range**

2.3 LOCKS

A. Combination Padlock: **Provided by Owner**.

2.4 LOCKER BENCHES

A. Manufacturers:

1. Penco Products, Inc.
2. Centar Industries, Inc.
3. Lyon LLC

B. Provide bench units with overall assembly height of **17-1/2 inches.**

C. Bench Tops: Manufacturer's standard one-piece units, with rounded corners and edges.

1. Size: Minimum 9-1/2 inches wide by 1-1/4 inches thick
2. Laminated clear hardwood with one coat of clear sealer on all surfaces and one coat of clear lacquer on top and sides.

D. Fixed-Bench Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top and anchoring to floor, complete with fasteners and anchors.

1. Color: **Match metal lockers**

E. Materials:

1. Stainless Steel Plate, Sheet, and Strip: ASTM A240/A240M or ASTM A666, Type 304.
2. Steel Tube: ASTM A500/A500M, cold rolled.

2.5 FABRICATION

A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.

B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.

C. Equipment: Provide each locker with an identification plate and the following equipment:

1. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.

D. Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds smooth and flush.

E. Accessible Lockers: Fabricate as follows:

1. Locate bottom shelf no lower than 15 inches above the floor.
2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.

F. Continuous Zee Base: Fabricated in lengths as long as practical to enclose base and base ends; finished to match lockers.

G. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.

H. Boxed End Panels: Fabricated with 1-inch-wide edge dimension, and designed for concealing fasteners and holes at exposed ends of nonrecessed metal lockers; finished to match lockers.

I. Finished End Panels: Fabricated to conceal unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lockers level, plumb, and true; shim as required, using concealed shims.

1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
2. Anchor single rows of metal lockers to walls near top **and bottom of lockers.**
3. Anchor back-to-back metal lockers to floor.

B. Welded Lockers: Connect groups together with manufacturer's standard fasteners, with no exposed fasteners on face frames.

C. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

1. Attach filler panels with concealed fasteners.

D. Fixed Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than 72 inches apart.

END OF SECTION 105113

SECTION 107316 - CANOPIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fixed canopies.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, sections, mounting heights, and attachment details.
2. Detail fabrication and assembly of canopies, including layout, spacing, of hanger rods, drain beam and leader location.

C. Samples: For each exposed product and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 WARRANTY

A. Special Warranty: Manufacturer and fabricator agree to repair or replace components of canopies that fail in materials or workmanship within specified warranty period.

1. Canopy Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 CANOPY FRAME AND ACCESSORY MATERIALS

A. Aluminum: Alloy and temper recommended by canopy manufacturer for type of use and finish indicated and with not less than the strength and durability properties of alloy and temper required by structural loads.

1. Aluminum Plate and Sheet: ASTM B209 (ASTM B209M).
2. Aluminum Extrusions: ASTM B221 (ASTM B221M) All extruded (T6-6063).
3. Extruded Structural Pipe and Round Tubing: ASTM B429/B429M, standard weight (Schedule 40).
4. Drawn Seamless Tubing: ASTM B210 (ASTM B210M).
5. Fascia - .125”
6. Decking – extruded 2-3/4” deep, 0.078”.

B. Anchors, Fasteners, Fittings, Hardware, and Installation Accessories: Complying with performance requirements indicated and suitable for exposure conditions, supporting structure, anchoring substrates, and installation methods indicated. Corrosion-resistant or noncorrodible units; weather-resistant, tamperproof, compatible, nonstaining materials. Provide as required for canopy assembly, mounting, and secure attachment. Number as needed to comply with performance requirements and to maintain uniform appearance; evenly spaced. All fasteners shall be as required & specified by the manufacturer for each application. Each fastener shall meet the individual structural requirements necessary to comply with all loading requirements per the NY State Building Code, current version. Where exposed to view, provide finish and color as selected by Architect from manufacturer's full range.

1. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing according to ASTM E488 conducted by a qualified independent testing and inspecting agency.

    a. Material: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2 (ASTM F738M and ASTM F836M, Grade A1 or A4).

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187.

2.3 FIXED CANOPY FABRICATION

A. Basis of Design: Super Lumideck Flat Soffit as manufactured by Mapes Architectural Canopies.

B. Manufacturers: Subject to compliance with requirements, other available manufacturers offering products that may be incorporated into the Work, will be reviewed for conformance to the specifications and requirements contained herein.

1. Frame Fabrication: Fabricate canopy frames from extruded aluminum (T6-6063). Preassemble in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations.
2. Form exposed work true to line and level with accurate angles and surfaces and straight edges.
3. Weld corners and connections continuously. Obtain fusion without undercut or overlap. Remove welding flux immediately. At exposed corners and connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
4. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure canopies in place and to properly transfer loads.

C. Aluminum Finish: High-Performance Organic Finish (Two-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coating; Organic Coating: manufacturer's standard two-coat, thermo-cured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Engineer/Architect from full range of industry colors and color densities.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install canopies at locations and in position indicated, securely connected to supports, free of rack, and in proper relation to adjacent construction. Use mounting methods of types described and in compliance with Shop Drawings and fabricator's written instructions.

B. Weld frame connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.

C. Anchoring to In-Place Construction: Use anchors, fasteners, fittings, hardware, and installation accessories where necessary for securing canopies to structural support and for properly transferring load to in-place construction.

D. Corrosion Protection: Coat concealed surfaces of aluminum that come in contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

END OF SECTION 107316

SECTION 123553.13 - METAL LABORATORY CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal laboratory casework.
2. Utility-space framing at backs of base cabinets.
3. Filler and closure panels.
4. Laboratory countertops.
5. Tables.
6. Shelves.
7. Laboratory sinks.
8. Laboratory accessories.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For laboratory casework. Include plans, elevations, sections, and attachments to other work including blocking and reinforcements required for installation.

C. Samples: For casework finishes and materials requiring color selection.

D. Delegated-Design Submittal: For laboratory casework indicated to comply with seismic performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

PART 2 - PRODUCTS

2.1 METAL LABORATORY CASEWORK

A. Basis of Design manufacturer: Kewaunee Scientific Corporation

B. Manufacturers: Subject to compliance with requirements, other available manufacturers offering products that may be incorporated into the Work. The Laboratory Casework and the Laboratory Fume Hood shall be provided by the same manufacturer and the contractor must coordinate with the M-contract.

C. Product Designations: Drawings indicate sizes and configurations of laboratory casework by referencing designated manufacturer's catalog numbers. Other manufacturers' laboratory casework of similar sizes and similar door and drawer configurations and complying with Specifications may be considered. See Section 016000 "Product Requirements."

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design laboratory casework installation.

B. Seismic Performance: Laboratory casework installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Design earthquake spectral response acceleration, short period (Sds) for Project is indicated on Drawings.
2. Component Importance Factor: 1.0.
3. Base Cabinet Load (Including Countertop and Load on Countertop): 320 lb/ft.
4. Wall Cabinet (Upper Cabinet) Load: 160 lb/ft.

2.3 CASEWORK, GENERAL

A. Casework Product Standard: Comply with SEFA 8 M, "Laboratory Grade Metal Casework."

B. Flammable Liquid Storage: Where cabinets are indicated for solvent or flammable liquid storage, provide units that are listed and labeled as complying with requirements in NFPA 30 by a testing and inspecting agency acceptable to authorities having jurisdiction.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.4 METAL CASEWORK MATERIALS

A. Steel Sheet: Cold-rolled, commercial steel (CS) sheet, complying with ASTM A1008/A1008M; matte finish; suitable for exposed applications.

2.5 AUXILIARY CABINET MATERIALS

A. Acid Storage-Cabinet Lining: 1/4-inch thick, polyethylene, polypropylene, epoxy, or phenolic-composite lining material.

B. Glass for Glazed Doors: Clear tempered glass complying with ASTM C1048, Kind FT, Condition A, Type I, Class 1, Quality-Q3; not less than 5.0 mm thick.

2.6 CABINET HARDWARE

A. General: Provide laboratory casework manufacturer's standard, commercial-quality, heavy-duty hardware complying with requirements indicated for each type.

B. Hinges: lol-steel, five-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips.

C. Hinged-Door and Drawer Pulls: stainless-steel back-mounted pulls.

D. Sliding-Door Pulls: Stainless-steel recessed flush pulls.

E. Door Catches: Nylon-roller spring catches. Provide two catches on doors more than 48 inches high.

F. Drawer Slides: Manufacturer's standard.

G. Locks: Cam or half-mortise type, brass with chrome-plated finish; complying with BHMA A156.11, Type E07261

1. Tumbler: Disc
2. Lock Locations: Provide on drawers and doors
3. Keying: Key locks alike within each room; key each room separately

    a. Masterkey for up to 225 key changes.

4. Key Quantity: Minimum of two keys per lock.
5. Master Key System: Key locks to be operable by master key.

    a. Master Keys: Provide two**.**

H. Sliding-Door Hardware Sets: Laboratory casework manufacturer's standard, to suit type and size of sliding-door units.

2.7 METAL CABINETS AND TABLES

A. Fabrication: Assemble and finish units at point of manufacture. Use precision dies for interchangeability of like-size drawers, doors, and similar parts. Perform assembly on precision jigs to provide units that are square. Reinforce units with angles, gussets, and channels. Except where otherwise specified, integrally frame and weld cabinet bodies to form dirt- and vermin-resistant enclosures. Where applicable, reinforce base cabinets for sink support. Maintain uniform clearance around door and drawer fronts of 1/16 to 3/32 inch.

B. Flush Doors: Outer and inner pans that nest into box formation, with full-height channel reinforcements at center of door. Fill doors with noncombustible, sound-deadening material.

C. Glazed Doors: Hollow-metal stiles and rails of similar construction as flush doors, with glass held in resilient channels or gasket material.

D. Hinged Doors: Mortise for hinges and reinforce with angles welded inside inner pans at hinge edge.

E. Drawers: Fronts made from outer and inner pans that nest into box formation, without raw metal edges at top. Sides, back, and bottom fabricated in one piece with rolled or formed top of sides for stiffening and comfortable grasp for drawer removal. Provide drawers with rubber bumpers, polymer roller slides, and positive stops to prevent metal-to-metal contact or accidental removal.

F. Adjustable Shelves: Front, back, and ends formed down, with edges returned horizontally at front and back to form reinforcing channels.

G. Toe Space: Fully enclosed, 4 inches high by 3 inches deep, with no open gaps or pockets.

H. Tables: Welded tubing legs, not less than 2 inches square with channel stretchers as needed to comply with product standard. Weld or bolt stretchers to legs and cross-stretchers, and bolt legs to table aprons. Provide leveling device welded to bottom of each leg.

1. Leg Shoes: Rubber Satin-finished, stainless-steel, open-bottom, slip-on type.

I. Utilities: Provide space, cutouts, and holes for pipes, conduits, and fittings in cabinet bodies to accommodate utility services and their support-strut assemblies.

1. Provide base cabinets with removable backs for access to utility space.

J. Utility-Space Framing: Steel framing units consisting of two steel slotted channels complying with MFMA-4, not less than 1-5/8 inches square by 0.105-inch nominal thickness, that are connected at top and bottom by U-shaped brackets made from 1-1/4-by-1/4-inch steel flat bars. Framing units may be made by welding channel material into rectangular frames instead of using U-shaped brackets.

K. Filler and Closure Panels: Provide where indicated and as needed to close spaces between casework and walls, ceilings, and equipment. Fabricate from same material and with same finish as casework and with hemmed or flanged edges unless otherwise indicated.

2.8 METAL CABINET FINISH

A. Chemical-Resistant Finish: Finish complies with acceptance levels of cabinet surface finish tests in SEFA 8 M. Acceptance level for chemical spot test shall be no more than for Level 3 conditions.

1. Colors for Metal Laboratory Casework Finish: As selected by Architect from manufacturer's full range.

2.9 COUNTERTOPS, TABLETOPS, SHELVES, TROUGHS, AND SINKS

A. Countertops, General: Provide units with smooth surfaces in uniform plane, free of defects. Make exposed edges and corners straight and uniformly beveled. Provide front and end overhang of 1 inch.

B. Sinks, General: Provide sizes indicated or laboratory casework manufacturer's closest standard size of equal or greater volume, as approved by Architect.

1. Outlets: Provide with strainers and tailpieces, NPS 1-1/2 (DN 40), unless otherwise indicated.
2. Overflows: For each sink except cup sinks, provide overflow of standard beehive or open-top design with separate strainer. Height 2 inches (50 mm) less than sink depth. Provide in same material as strainer.

C. Phenolic-Composite Countertops, Tabletops and Shelves:

1. Countertop Fabrication: Fabricate with cutouts for sinks, holes for service fittings and accessories, and butt joints assembled with epoxy adhesive and concealed metal splines.

    a. Flat Configuration: 1 inch thick with continuous drip groove on underside 1/2 inch from overhang edge and integral coved backsplash.

        1) Edges and Corners: Rounded.

2. Tabletop Fabrication:

    a. Flat Configuration: 1 inch thick with continuous drip groove on underside at perimeter.

        1) Edges and Corners: Rounded.

3. Shelf Configuration: Flat, 3/4 inch thick.

    a. Edges and Corners: Rounded.

D. Stainless-Steel Shelves: Made from stainless-steel sheet, not less than 0.050-inch nominal thickness, with No. 4 satin finish. Weld shop-made joints. Fold down front edge 3/4 inch; fold up back edge 3 inches.

1. Provide integral stiffening brackets, formed by folding up ends 3/4 inch and welding to upturned front and back edges.
2. After fabricating, grind welds smooth and polish to produce uniform, directionally textured finish with no cross scratches or evidence of welds. Passivate and rinse surfaces; remove embedded foreign matter and leave surfaces clean.

E. Stainless-Steel Sinks: Made from stainless-steel sheet, not less than 0.050-inch nominal thickness. Fabricate with corners rounded and coved to at least 5/8-inch radius. Slope sink bottoms to outlet. Provide continuous butt-welded joints.

1. Provide double-wall construction for sink partitions with top edge rounded to at least 1/2-inch diameter.
2. After fabricating and welding, grind surfaces smooth and polish to produce uniform finish with no cross scratches or evidence of welds. Passivate and rinse surfaces; remove embedded foreign matter and leave surfaces clean.
3. Factory punch holes for fittings.
4. Provide with stainless-steel strainers and tailpieces.
5. Provide with integral rims except where located in stainless-steel countertops.
6. Apply 1/8-inch- thick coating of heat-resistant, sound-deadening mastic to undersink surfaces.

F. Cup Sinks: Provide in material indicated, 3-by-9-inch

1. Stainless-Steel Cup Sinks: Provide with stainless-steel strainers and integral tailpieces.

G. Troughs: Provide in material indicated and pitch to drains not less than 1/8 inch/foot. Except where troughs empty into sinks, provide NPS 1-1/2 (DN 40) outlets with strainers and tailpieces.

1. Stainless-Steel Troughs: Made from stainless-steel sheet, not less than 0.062-inch nominal thickness. Fabricate with corners rounded and coved to at least 5/8-inch radius. Provide continuous butt-welded joints. After fabricating and welding, grind surfaces smooth and polish to produce uniform finish with no cross scratches or evidence of welds. Passivate and rinse surfaces; remove embedded foreign matter and leave surfaces clean. Provide stainless-steel strainers and tailpieces.

2.10 LABORATORY ACCESSORIES

A. Reagent Shelves: Provide as indicated, fabricated from same material as adjacent countertop unless otherwise indicated.

B. Burette Rods: Aluminum or stainless-steel rods, 1/2 inch in diameter and 18 inches long, threaded on one end to fit tapered plug adapter for flush socket receptacle. Provide with tapered plug adapter and receptacle.

C. Upright Rod Assembly and Metal Crossbar: Aluminum or stainless steel. Two vertical rods and one horizontal crossbar, 3/4 inch in diameter and 36 inches long unless otherwise indicated; two flush socket receptacles and two crossbar clamps. Ends of vertical rods are tapered to fit receptacles; other rod ends are rounded.

D. Greenlaw Arm Assembly: Aluminum or stainless-steel vertical rod, tapered on one end to fit flush socket receptacle. Adjustable crossbar of hardwood with black, acid-resistant finish, secured to upright with adjustable clamp. Provide with receptacle.

E. Lattice Assembly: Aluminum or stainless-steel, vertical and horizontal rod lattice assembly with 3/4-inch- diameter rods at approximately 12 inches o.c. with two flush socket receptacles for mounting.

1. Size: 36 inches wide by 24 inches high.

F. Pegboards: Polypropylene, epoxy, or phenolic-composite pegboards with removable polypropylene pegs and stainless-steel drip troughs with drain outlet.

G. Pegboards: Stainless-steel pegboards with removable polypropylene pegs and stainless-steel drip troughs with drain outlet.

PART 3 - EXECUTION

3.1 INSTALLATION OF CABINETS

A. Comply with installation requirements in SEFA 2. Install level, plumb, and true in line; shim as required using concealed shims. Where laboratory casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

B. Utility-Space Framing: Secure to floor with two fasteners at each frame. Fasten to partition framing, wood blocking, or metal reinforcements in partitions and to base cabinets.

C. Base Cabinets: Fasten cabinets to utility-space framing, partition framing, wood blocking, or reinforcements in partitions, with fasteners spaced not more than 16 inches o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform.

1. Where base cabinets are installed away from walls, fasten to floor at toe space at not more than 24 inches o.c. and at sides of cabinets with not less than two fasteners per side.

D. Wall Cabinets: Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 16 inches o.c.

E. Install hardware uniformly and precisely.

F. Adjust operating hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.

3.2 INSTALLATION OF COUNTERTOPS

A. Comply with installation requirements in SEFA 2. Abut top and edge surfaces true in plane with flush hairline joints and with internal supports placed to prevent deflection. Locate joints where indicated on Shop Drawings.

B. Field Jointing: Where possible, make in same manner as shop-made joints, using dowels, splines, fasteners, adhesives, and sealants recommended by manufacturer. Shop prepare edges for field-made joints.

1. Plastic-Laminate Countertops: Secure field-made joints using concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches . Tighten according to manufacturer's written instructions to exert a uniform heavy pressure at joints.

C. Fastening:

1. Secure countertops, except for epoxy countertops, to cabinets with Z-type fasteners or equivalent, using two or more fasteners at each cabinet front, end, and back.
2. Secure epoxy countertops to cabinets with epoxy cement, applied at each corner and along perimeter edges at not more than 48 inches o.c.

3. Where necessary to penetrate countertops with fasteners, countersink heads approximately 1/8 inch and plug hole flush with material equal to countertop in chemical resistance, hardness, and appearance.

D. Provide holes and cutouts required for service fittings.

E. Seal unfinished edges and cutouts in plastic-laminate countertops with heavy coat of polyurethane varnish.

F. Provide scribe moldings for closures at junctures of countertop, curb, and splash with walls as recommended by manufacturer for materials involved. Match materials and finish to adjacent laboratory casework. Use chemical-resistant, permanently elastic sealing compound where recommended by manufacturer.

G. Dress joints smooth, remove surface scratches, and clean entire surface.

3.3 INSTALLATION OF SINKS

A. Comply with installation requirements in SEFA 2.

B. Drop-in Installation of Epoxy Sinks: Rout groove in countertop to receive sink rim if not shop prepared. Set sink in adhesive and fill remainder of groove with sealant or adhesive. Use procedures and products recommended by sink and countertop manufacturers. Remove excess adhesive and sealant while still wet and finish joint for neat appearance.

C. Underside Installation of Epoxy Sinks: Use laboratory casework manufacturer's recommended adjustable support system for table- and cabinet-type installations. Set top edge of sink unit in sink and countertop manufacturers' recommended chemical-resistant sealing compound or adhesive, and firmly secure to produce a tight and fully leakproof joint. Adjust sink and securely support to prevent movement. Remove excess sealant or adhesive while still wet and finish joint for neat appearance.

D. Semiflush Installation of Stainless-Steel Sinks: Before setting, apply sink and countertop manufacturers' recommended sealant under rim lip and along top. Remove excess sealant while still wet and finish joint for neat appearance.

E. Drop-in Installation of Cup Sinks: Rout groove in countertop to receive sink rim if not shop prepared. Set sink in adhesive and fill remainder of groove with sealant or adhesive. Use procedures and products recommended by sink and countertop manufacturers. Remove excess adhesive and sealant while still wet and finish joint for neat appearance.

F. Surface Installation of Cup Sinks: Set sink in sealant or adhesive. Use procedures and products recommended by sink and countertop manufacturers. Remove excess sealant or adhesive while still wet and finish joint for neat appearance.

3.4 INSTALLATION OF LABORATORY ACCESSORIES

A. Install accessories according to Shop Drawings, installation requirements in SEFA 2, and manufacturer's written instructions.

B. Securely fasten adjustable shelving supports, stainless-steel shelves, and pegboards to partition framing, wood blocking, or reinforcements in partitions.

C. Install shelf standards plumb and at heights to align shelf brackets for level shelves. Install shelving level and straight, closely fitted to other work where indicated.

D. Securely fasten pegboards to partition framing, wood blocking, or reinforcements in partitions.

3.5 CLEANING AND PROTECTING

A. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

B. Protect countertop surfaces during construction with 6-mil plastic or other suitable water-resistant covering. Tape to underside of countertop at a minimum of 48 inches o.c.

END OF SECTION 123553.13

SECTION 123640 - STONE COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes stone countertops.

1.2 ACTION SUBMITTALS

A. Product Data: For each variety of stone, stone accessory and manufactured product.

B. Shop Drawings: Include plans, sections, details, and attachments to other work.

C. Samples: For each stone type indicated.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of stone countertops.

1.4 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of construction to receive stone countertops by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Stone: Obtain each variety of stone, regardless of finish, from a single quarry, whether specified in this Section or in another Specification Section, with resources to provide materials of consistent quality in appearance and physical properties.

1. Make stone slabs available for examination by Architect.

2.2 GRANITE

A. Material Standard: Comply with ASTM C615/C615M.

B. Varieties and Sources: Subject to compliance with requirements, provide one of the following available stone varieties that may be incorporated into the Work include, but are not limited to, the following:

1. Provide polished granite countertops from StoneMark Granite, Daltile, or other acceptable granite countertop supplier.

C. Finish: Polished.

2.3 ADHESIVES, GROUT, SEALANTS, AND STONE ACCESSORIES

A. General: Use only adhesives formulated for stone and ceramic tile and that are recommended by their manufacturer for the application indicated.

B. Water-Cleanable Epoxy Adhesive: ANSI A118.3.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Bonsal American, an Oldcastle company.
   b. H.B. Fuller Construction Products Inc. / TEC.
   c. LATICRETE SUPERCAP, LLC.
   d. MAPEI Corporation.

C. Water-Cleanable Epoxy Grout: ANSI A118.3, chemical-resistant, water-cleanable, tile-setting and -grouting epoxy.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Bonsal American, an Oldcastle company.
   b. H.B. Fuller Construction Products Inc. / TEC.
   c. LATICRETE SUPERCAP, LLC.
   d. MAPEI Corporation.

D. Sealant for Countertops: Manufacturer's standard sealant that complies with applicable requirements in Section 079200 "Joint Sealants" and that will not stain the stone it is applied to.

1. Mildew-Resistant Joint Sealant: Mildew resistant, single component, non-sag, neutral curing, silicone.
2. Color: Clear.

E. Particleboard Sub-tops: ANSI A208.1, Grade M-2-Exterior Glue.

F. Plywood Sub-tops: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

G. Stone Sealer: Colorless, stain-resistant sealer that does not affect color or physical properties of stone surfaces, as recommended by stone producer for application indicated.

2.4 STONE FABRICATION, GENERAL

A. Select stone for intended use to prevent fabricated units from containing cracks, seams, and starts that may impair structural integrity, function, or appearance.

B. Fabricate stone countertops in sizes and shapes required to comply with requirements indicated.

1. Dress joints straight and at right angle to face unless otherwise indicated.
2. Fabricate molded edges with machines having abrasive shaping wheels made to reverse contour of edge profile to produce uniform shape throughout entire length of edge and with precisely formed arris slightly eased to prevent snipping, and matched at joints between units. Form corners of molded edges as indicated with outside corners slightly eased unless otherwise indicated.
3. Finish exposed faces of stone to comply with requirements indicated for finish of each stone type required and to match approved Samples and mockups. Provide matching finish on exposed edges of countertops, splashes, and cutouts.

2.5 STONE COUNTERTOPS

A. General: Comply with recommendations in MIA's "Dimension Stone - Design Manual VII."

B. Nominal Thickness: Provide thickness indicated, but not less than 7/8 inch. Gage backs to provide units of identical thickness.

C. Splashes: Provide 3/4-inch thick backsplashes and end splashes unless otherwise indicated.

D. Joints: Fabricate countertops without joints.

E. Joints: Fabricate countertops in sections for joining in field, with joints at locations to be determined.

F. Cutouts and Holes:

1. Undercounter Fixtures: Make cutouts for undercounter fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
2. Counter-Mounted Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

PART 3 - EXECUTION

3.1 INSTALLATION OF COUNTERTOPS

A. Install countertops over sub-tops with full spread of water-cleanable epoxy adhesive.

B. Install countertops by adhering to supports with water-cleanable epoxy adhesive.

C. Set stone to comply with requirements indicated. Shim and adjust stone to locations indicated, with uniform joints of widths indicated and with edges and faces aligned according to established relationships.

D. Space joints with 1/16-inch gap for filling with sealant. Use temporary shims to ensure uniform spacing.

1. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.

E. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Use power saws with diamond blades to cut stone. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

F. Install backsplashes and end splashes by adhering to wall with water-cleanable epoxy adhesive. Leave 1/16-inch gap between countertop and splashes for filling with sealant. Use temporary shims to ensure uniform spacing.

G. Grout joints to comply with ANSI A108.10. Remove temporary shims before grouting. Tool grout uniformly and smoothly with plastic tool.

H. Apply sealant to joints and gaps specified for filling with sealant; comply with Section 079200 "Joint Sealants." Remove temporary shims before applying sealant.

3.2 ADJUSTING AND CLEANING

A. In-Progress Cleaning: Clean countertops as work progresses. Remove adhesive, grout, mortar, and sealant smears immediately.

B. Clean stone countertops no fewer than six days after completion of sealant installation, using clean water and soft rags. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that may damage stone.

C. Sealer Application: Apply stone sealer to comply with stone producer's and sealer manufacturer's written instructions.

END OF SECTION 123640

SECTION 124813 - ENTRANCE FLOOR MATS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roll-up rail mats.
2. Recessed frames.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Items penetrating floor mats and frames, including door control devices.
2. Divisions between mat sections.
3. Perimeter floor moldings and frames.
4. Custom Graphics: Scale drawing indicating colors.

C. Samples: For each exposed product and for each color and texture specified.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 ENTRANCE FLOOR MATS AND FRAMES, GENERAL

A. Accessibility Standard: Comply with applicable provisions in ICC A117.1.

2.2 ROLL-UP RAIL MATS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Babcock-Davis.
2. C/S Group.
3. Kadee Industries, Inc.

B. Hinged Mats: Extruded-aluminum tread rails 1-1/2 inches wide by 3/8 inch thick, sitting on continuous vinyl cushions.

1. Tread Inserts: 1/4-inch-high, 28-oz./sq. yd. weight, level-cut, nylon-pile, fusion-bonded carpet.
2. Colors, Textures, and Patterns of Inserts: As selected by Engineer/Architect from full range of industry colors.
3. Rail Color: As selected by Engineer/Architect from full range of industry colors and color densities.
4. Hinges: Plastic.
5. Mat Size: As indicated.

2.3 FRAMES

A. Recessed Frames: Manufacturer's standard extrusion.

1. Extruded Aluminum: ASTM B221.

a. Color: As selected by Engineer/Architect from full range of industry colors and color densities.

2.4 FABRICATION

A. Floor Mats: Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.

B. Coat concealed surfaces of aluminum frames that contact cementitious material with manufacturer's standard protective coating.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install recessed mat frames and mats to comply with manufacturer's written instructions so that tops of mats will be flush with adjoining finished flooring. Set mats with tops at height recommended by manufacturer for most effective cleaning action; coordinate tops of mat surfaces with bottoms of doors that swing across mats to give clearance between door and mat.

3.2 PROTECTION

A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

END OF SECTION 124813

SECTION 133419 - METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural-steel framing.
2. Metal roof panels.
3. Metal wall panels.
4. Metal soffit panels.
5. Thermal insulation.
6. Insulation Support System
7. Accessories.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of metal building system component.

B. Shop Drawings: Indicate components by others. Include full building plan, elevations, sections, details and attachments to other work.

C. Samples: For units with factory-applied finishes.

D. Delegated-Design Submittal: For metal building systems.

1. Include analysis data indicating compliance with performance requirements and design data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:

1. Name and location of Project.
2. Order number.
3. Name of manufacturer.
4. Name of Contractor.

5. Building dimensions including width, length, height, and roof slope.
6. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
7. Governing building code and year of edition.
8. Design Loads: Include dead load, roof live load, collateral loads, equipment loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).
9. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
10. Building-Use Category: Indicate category of building use and its effect on load importance factors.

C. Material test reports.

D. Source quality-control reports.

E. Field quality-control reports.

F. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer.

1. Accreditation: Manufacturer's facility accredited according to the International Accreditation Service's AC472, "Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems."
2. Engineering Responsibility: Preparation of comprehensive engineering analysis and Shop Drawings by a professional engineer who is legally qualified to practice in jurisdiction where Project is located.

B. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.7 WARRANTY

A. Special Warranty on Metal Panel Finishes: Manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Finish Warranty Period: 20 years from date of Substantial Completion.

B. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. American Buildings Company; a Nucor Company.
2. Butler Manufacturing Company; a division of BlueScope Buildings North America, Inc.
3. Metallic Building Company.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, licensed and registered in New York State, as defined in Section 014000 "Quality Requirements," to design metal building system.

B. Structural Performance: Metal building systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA's "Metal Building Systems Manual."

1. Design Loads: As indicated on Drawings.
2. Deflection and Drift Limits: Design metal building system assemblies to withstand serviceability design loads without exceeding deflections and drift limits recommended in AISC Steel Design Guide No. 3 "Serviceability Design Considerations for Steel Buildings."
3. Deflection and Drift Limits: No greater than the following:

a. Purlins and Rafters: Vertical deflection of 1/240 of the span.
b. Girts: Horizontal deflection of 1/180 of the span.
c. Metal Roof Panels: Vertical deflection of 1/240 of the span.
d. Metal Wall Panels: Horizontal deflection of 1/180 of the span.
e. Design secondary-framing system to accommodate deflection of primary framing and construction tolerances, and to maintain clearances at openings.

f. Design primary secondary framing to maintain deflection criteria for all equipment that will be operational, i.e. gym separation nets, basketball backboards, etc.

4. Reinforced Lower Wall Panel:

a. The lower 48” of all exterior walls shall be additional reinforced to resist lateral snow loads. The load of concern is a result of snow sliding from the roof above and accumulating such that a lateral load is imparted on the lower 48” of the exterior wall.

C. Seismic Performance: Metal building system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

E. Fire-Resistance Ratings: Where assemblies are indicated to have a fire-resistance rating, provide metal panel assemblies identical to those of assemblies tested for fire resistance per ASTM E119 or ASTM E108 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory," FM Global's "Approval Guide," or from the listings of another qualified testing agency.

F. Structural Performance for Metal Roof and Wall Panels: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings and as calculated in accordance with ASCE 7.

G. Air Infiltration for Metal Roof Panels: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E1680 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft..

H. Air Infiltration for Metal Wall Panels: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft..

I. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E1646 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft..

J. Water Penetration for Metal Wall Panels: No water penetration when tested according to ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft.].

K. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 90.

L. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.

1. Fire/Windstorm Classification: Class 1A-120.
2. Hail Resistance: MH.

M. Thermal Performance for Opaque Elements: Provide the following maximum U-factors and minimum R-values when tested according to ASTM C1363 or ASTM C518:

1. Roof:
   a. R-Value: R=25 fiberglass insulation w/ vinyl vapor retarder (interior side) + R=11unfaced insulation on the exterior side.

2. Walls:
   a. R-Value: R=13 ci (2” continuous insulation) + R=25 (8” kraft-faced fiberglass insulation).

2.3 STRUCTURAL-STEEL FRAMING

A. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings."

B. Bolted Connections: Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts."

C. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.

D. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafters and rake beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.

1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.

   a. Slight variations in span and spacing may be acceptable if necessary to comply with manufacturer's standard, as approved by Architect.
2. Exterior Column: Uniform depth or tapered depth.
3. Rafter: Uniform depth or tapered depth.

E. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other

miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, prepainted with coil coating, to comply with the same requirements as primary steel. Supplemental steel shall be provided to support all material and equipment loads including but not limited to suspended ceilings, HVAC components (ductwork,etc) and gym equipment (basketball backboards, operational separation netting etc).

F. Anchor Rods: Headed anchor rods as indicated in Anchor Rod Plan for attachment of metal building to foundation.

2.4 METAL ROOF PANELS

A. Comply with requirements in Section 074113.16 "Standing-Seam Metal Roof Panels" for roofing panel

2.5 METAL WALL PANELS

A. Concealed-Fastener, Flush-Profile, Metal Wall Panels: Formed with vertical panel edges and a single wide recess, centered between panel edges flush surface; with flush joint between panels; with 1-inch-wide flange for attaching interior finish; designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps.

1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.030-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Exterior Finish: Two-coat Fluoropolymer.
    b. Color: As selected by Architect from manufacturer's full range.

2. Panel Coverage: 16 inches.
3. Panel Height: 1.5 inches.

2.6 METAL SOFFIT PANELS

A. General: Provide factory-formed metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories required for weathertight installation.

B. Metal Soffit Panels: V-Groove-Profile Metal Soffit Panels to be a combination of perforated and solid formed panels to include intermediate stiffening ribs between panel edges.

1. Finish: As selected by Architect from manufacturer's full range.

2.7 THERMAL INSULATION

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Bay Insulation Systems; a division of Bay Industries.

B. Faced Metal Building Insulation: ASTM C991, Type II, glass-fiber-blanket insulation; 0.5-lb/cu. ft. density; 2-inch-wide, continuous, vapor-tight edge tabs; with a flame-spread index of 25 or less.

C. Unfaced Metal Building Insulation: ASTM C991, Type I, or NAIMA 202, glass-fiber-blanket insulation; 0.5-lb/cu. ft. density; 2-inch-wide, continuous, vapor-tight edge tabs; with a flame-spread index of 25 or less.

D. Retainer Strips: For securing insulation between supports, 0.025-inch nominal-thickness, formed, metallic-coated steel or PVC retainer clips colored to match insulation facing.

E. Vapor-Retarder Facing: ASTM C1136, with permeance not greater than 0.02 perm when tested according to ASTM E96/E96M, Desiccant Method.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Lamtec Corporation.

2.8 INSULATION SUPPORT SYSTEM

A. Insulation Support System Basis of Design: "Sky-Web® II" insulation support system as manufactured by Dupont, Inc.

B. Description:
1. Compatible with roof system.
2. Limit to "over-the-purlin" type insulation systems.
3. Knotted Mesh:
   a. Grid: Nominal 2-3/4 inches by 2-3/4 inches.
   b. Material: Twisted twine of DuPont nylon Type 6-6 fiber.
   c. Mesh Covering Interior Bays: 21-pound twine.
   d. Five-Foot Strip Along Edge: #30 twine, with edge color coded for identification.
4. Double selvage along the 2 edges in machine direction.
5. Furnish up to 60 feet wide by building width.
   a. Cover 1 or 2 bays of building length and extend eave-to-eave across building.

C. Physical Properties:
1. Minimum Tensile Strength: #30 Twine: 265 pounds.
2. Runnage: #30 Twine: 605 feet per pound.
3. Cord Used to Make Mesh-to-Mesh Edge Connections: #36 DuPont nylon Type 6-6 white braided twine.

4. Minimum Tensile Strength: 360 pounds.
5. Runnage: 533 feet per pound.
6. Mesh Weight: 0.012 pounds per sq ft.

D. Fasteners and Attachment Hardware:
1. Connections to Eave and Gable Members:
a. 1/8-inch-diameter wire clips looped through 20-gauge steel V-straps.
b. Steel V-Straps: Fasten to framing with self-drilling screws.
2. Mesh-to-Mesh Edge Connections:
a. Lace #36 nylon cord through edges of pieces of mesh being connected.
b. Edge Connections: Plastic cable ties.

E. Fire-Hazard Classification:
1. UL Fire-Hazard Classification Ratings, UL 723:
a. Flame Spread: 3 or less.
Smoke Developed: Less than 10.

2.9 ACCESSORIES

A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.

1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.

C. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including copings, fascias, mullions, sills, corner units, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels unless otherwise indicated.

D. Flashing and Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, pre-painted with coil coating; finished to match adjacent metal panels.

E. Gutters: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, pre-painted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch-long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."

1. Gutter Supports: Fabricated from same material and finish as gutters.
2. Strainers: Bronze, copper, or aluminum wire ball type at outlets.

F. Downspouts: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, pre-painted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot-long sections, complete with formed elbows and offsets.

1. Mounting Straps: Fabricated from same material and finish as gutters.

G. Roof Curbs: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.048-inch nominal uncoated steel thickness pre-painted with coil coating; finished to match metal roof panels; with welded top box and bottom skirt, and integral full-length cricket; capable of withstanding loads of size and height indicated.

H. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.

2.10 FABRICATION

A. General: Design components and field connections required for erection to permit easy assembly.

1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.

B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.

C. Primary Framing: Shop fabricate framing components to indicated size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.

D. Secondary Framing: Shop fabricate framing components to indicated size and section by roll forming or break forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.

E. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

2.11 SOURCE QUALITY CONTROL

A. Special Inspection: Owner will engage a qualified special inspector to perform source quality control inspections and to submit reports.

1. Accredited Manufacturers: Special inspections will not be required if fabrication is performed by an IAS AC472-accredited manufacturer approved by authorities having jurisdiction to perform such Work without special inspection.

B. Product will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 ERECTION OF STRUCTURAL FRAMING

A. Erect metal building system according to manufacturer's written instructions and drawings.

B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.

C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.

D. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials and roughen surfaces prior to setting plates. Clean the bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.

F. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.

1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt type and joint type specified.

    a. Joint Type: Snug tightened or pretensioned as required by manufacturer.

G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.

1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.

2. Locate and space wall girts to suit openings such as doors and windows.
3. Provide supplemental framing at entire perimeter of openings, including doors, windows, ventilators, and other penetrations of roof and walls.

H. Steel Joists: Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders," joist manufacturer's written instructions, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
4. Joist Installation: Bolt joists to supporting steel framework using carbon-steel bolts unless otherwise indicated.
5. Joist Installation: Bolt joists to supporting steel framework using high-strength structural bolts unless otherwise indicated. Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for high-strength structural bolt installation and tightening requirements.
6. Joist Installation: Weld joist seats to supporting steel framework.
7. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

I. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.

1. Tighten rod and cable bracing to avoid sag.
2. Locate interior end-bay bracing only where indicated.

J. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.

K. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.

3.2 METAL PANEL INSTALLATION, GENERAL

A. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.

    a. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.

2. Install metal panels perpendicular to structural supports unless otherwise indicated.
3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.

4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Locate metal panel splices over structural supports with end laps in alignment.
6. Lap metal flashing over metal panels to allow moisture to run over and off the material.

B. Lap-Seam Metal Panels: Install screw fasteners using power tools with controlled torque adjusted to compress EPDM washers tightly without damage to washers, screw threads, or metal panels. Install screws in predrilled holes.

1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply metal panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated; or, if not indicated, provide types recommended by metal panel manufacturer.

1. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.3 METAL ROOF PANEL INSTALLATION

A. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.

1. Install ridge and hip caps as metal roof panel work proceeds.
2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.

B. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint, at location and spacing and with fasteners recommended by manufacturer.

1. Install clips to supports with self-drilling or self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
4. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so that clip, metal roof panel, and factory-applied sealant are completely engaged.
5. Rigidly fasten eave end of metal roof panels and allow ridge end free movement for thermal expansion and contraction. Predrill panels for fasteners.

6. Provide metal closures at peaks, rake edges, rake walls and each side of ridge and hip caps.

C. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

3.4 METAL WALL PANEL INSTALLATION

A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Unless otherwise indicated, begin metal panel installation at corners with center of rib lined up with line of framing.
2. Shim or otherwise plumb substrates receiving metal wall panels.
3. When two rows of metal panels are required, lap panels 4 inches minimum.
4. When building height requires two rows of metal panels at gable ends, align lap of gable panels over metal wall panels at eave height.
5. Rigidly fasten base end of metal wall panels and allow eave end free movement for thermal expansion and contraction. Predrill panels.
6. Flash and seal metal wall panels with weather closures at eaves and rakes, and at perimeter of all openings. Fasten with self-tapping screws.
7. Install screw fasteners in predrilled holes.
8. Install flashing and trim as metal wall panel work proceeds.
9. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated on Drawings; if not indicated, as necessary for waterproofing.
10. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws.
11. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.

B. Metal Wall Panels: Install metal wall panels on exterior side of girts. Attach metal wall panels to supports with fasteners as recommended by manufacturer.

3.5 METAL SOFFIT PANEL INSTALLATION

A. Provide metal soffit panels the full width of soffits. Install panels perpendicular to support framing.

B. Flash and seal metal soffit panels with weather closures where panels meet walls and at perimeter of all openings.

3.6 THERMAL INSULATION INSTALLATION

A. General: Install insulation concurrently with metal panel installation, in thickness indicated to cover entire surface, according to manufacturer's written instructions.

1. Set vapor-retarder-faced units with vapor retarder toward warm side of construction unless otherwise indicated. Do not obstruct ventilation spaces except for firestopping.
2. Tape joints and ruptures in vapor retarder and seal each continuous area of insulation to the surrounding construction to ensure airtight installation.
3. Install factory-laminated, vapor-retarder-faced blankets straight and true in one-piece lengths, with both sets of facing tabs sealed, to provide a complete vapor retarder.
4. Install blankets straight and true in one-piece lengths. Install vapor retarder over insulation, with both sets of facing tabs sealed, to provide a complete vapor retarder.

B. Blanket Roof Insulation: Comply with the following installation method:

1. Over-Framing Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal roof panels fastened to secondary framing.
2. Between-Purlin Installation: Extend insulation and vapor retarder between purlins. Carry vapor-retarder-facing tabs up and over purlin, overlapping adjoining facing of next insulation course and maintaining continuity of retarder. Hold in place with bands and crossbands below insulation.
3. Over-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Install layer of filler insulation over first layer to fill space formed by metal roof panel standoffs. Hold in place by panels fastened to standoffs.

    a. Thermal Spacer Blocks: Where metal roof panels attach directly to purlins, install thermal spacer blocks.

4. Two-Layers-between-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder between purlins. Carry vapor-retarder-facing tabs up and over purlin, overlapping adjoining facing of next insulation course and maintaining continuity of retarder. Install layer of filler insulation over first layer to fill space between purlins formed by thermal spacer blocks. Hold in place with bands and crossbands below insulation.

    a. Thermal Spacer Blocks: Where metal roof panels attach directly to purlins, install thermal spacer blocks.

5. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.

C. Blanket Wall Insulation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal wall panels fastened to secondary framing.

1. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.

3.7 DOOR AND FRAME INSTALLATION

A. General: Install doors and frames plumb, rigid, properly aligned, and securely fastened in place according to manufacturers' written instructions. Coordinate installation with wall flashings and

other components. Seal perimeter of each door frame with elastomeric sealant used for metal wall panels.

B. Personnel Doors and Frames: Install doors and frames according to NAAMM-HMMA 840.

1. At fire-rated openings, install frames according to, and doors with clearances specified in, NFPA 80.

C. Field Glazing: Comply with installation requirements in Section 088000 "Glazing."

D. Door Hardware:

1. Install surface-mounted items after finishes have been completed at heights indicated in DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
3. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
4. Set thresholds for exterior doors in full bed of sealant complying with requirements for concealed mastics specified in Section 079200 "Joint Sealants."

3.8 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
2. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
3. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible and set units true to line and level. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints

of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

C. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.
   1. Tie downspouts to underground drainage system indicated.

E. Roof Curbs: Install curbs at locations indicated on Drawings. Install flashing around bases where they meet metal roof panels.

F. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

3.9 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform field quality control special inspections and to submit reports.

B. Product will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 133419

SECTION 146001 – CRANES AND HOISTS

PART 1 – GENERAL

1.1 DESCRIPTION

A. Scope

1. This section specifies bridge cranes and hoisting equipment.
2. Runway beams and rail are part of the building steel package and are not included in this section.

B. Crane Summary

1. Span, Capacity, Crane Type, Classification : As indicated on the project plans.
2. Crane Speed, Crane Drive, Trolley Speed, Trolley Drive, Hoist Speeds, Hoist Type, Hoist Lift Required and Control: Per Crane Manufacturer

C. Work Includes the Following:

1. Detailed design of completed crane system, including bridge end trucks, trolley, joists, cabling, controls, rails, and connection between rail and runway beams and all appurtenances specified hereinafter.
2. Shop drawings.
3. Fabrication of a complete crane.
4. Inspection and shop testing.
5. Documentation and schedules.

1.2 REFERENCES

A. Equipment furnished under this section shall, except as otherwise noted, comply in all respects with the requirements of the following standards:

1. OSHA — Occupational Safety and Health Administration
   Part 1926.554 – Overhead Hoists
   Part 1910.179 – Overhead and Gantry Cranes

2. *CMAA — Crane Manufacturer's Association of America
   Specifications for Top Running Bridge & Gantry Type Multiple Girder Electric Overhead Traveling Cranes – No. 70 (2015)

Specifications for Top Running and Under Running Single Girder Electric Overhead Cranes Utilizing Under Running Trolley Hoist - No. 74 (2015)

3. *ANSI/ASME American National Standards Institute/ American Society of Mechanical Engineers
ANSI/ASME HST-4 – 2016 Performance Standard for Overhead Electric Wire Rope Hoists
ANSI/ASME B30.16 – 2017 Overhead Underhung and Stationary Hoists
ANSI/ASME B30.2 – 2016 Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)
ANSI/ASME B30.17 – 2015 Cranes and Monorails (with Underhung Trolley or Bridge)
ANSI/ASME B30.30 – 2019 Ropes

4. NEMA National Electric Manufacturer's Association

5. NEC National Electric Code – 2017
Article 100, Article 240-1, Article 430-31, Article 430-51, Article 610-1, Article 610-31

*Compliance to this standard is limited to the extent such standard is incorporated into and made mandatory by OSHA regulations.

1.3 SUBMITTALS

A. SHOP DRAWINGS AND EQUIPMENT DATA

1. Manufacturer's catalog data for hoist.
2. Dimensional drawings and details for bridge crane system.
3. Wiring schematics. – ship with crane

B. OPERATIONS AND MAINTENANCE MANUALS (one set of Owner's manuals in paper and flash drive)

1. Equipment function, normal operating characteristics, and limiting conditions.
2. Assembly, installation, alignment, and maintenance instructions.

3. Lubrication and maintenance instructions.
4. Guide to “troubleshooting”.
5. Parts list.
6. As-built drawing.
7. Test results.

1.4 APPLICABLE STANDARDS

A. Contractor shall adhere to OSHA, state and local safety guidelines, laws, rules and regulations.

B. Contractor shall conform to all applicable ANSI, CMAA, and HMI specifications and/or standards.

C. Comply with CMAA specification 70.

D. Long lead items (hoist, end trucks, drives and controls) will be ordered by contractor upon receipt of purchase order and credit approval. Steel will not be ordered until shop drawings and submittals have been approved by the EOR.

E. All electric equipment shall be UL, CSA c/us or ETL labeled.

1.5 WARRANTIES

A. Provide one-year equipment warranty.

PART 2 - PRODUCTS

2.1 ACCEPTABLE PRODUCTS

A. Bridge crane package systems shall be provided by: Sissco Material Handling Equipment, or approved equal.

B. Hoist shall be R&M Spacemaster SX electric wire rope type.

2.2 MATERIALS

Components	Material
Bridge beams	Steel, ASTM A36 or A992
End Trucks	Steel, ASTM A36 (or equal)
Trolley	Steel, ASTM A36 (or equal)
Wheels	Cast iron or steel
Hooks	Forged steel

2.3 EQUIPMENT

A. HOIST AND TROLLEY

1. Top-running and under-running single girder cranes shall utilize the Spacemaster SX low headroom or standard headroom electric wire rope hoists as manufactured by R&M Materials Handling Inc., Springfield, OH.

2. Top-running double girder cranes shall utilize the Spacemaster SX double girder trolley electric wire rope hoists as manufactured by R&M Materials Handling Inc., Springfield, OH.

3. The hoist shall be equipped with an electro-mechanical load-limiting device that shall prevent lifting more than 110% of the rated load.

4. Hoist and trolley motors shall be per 1.01B above, as applicable.

5. Hoisting motor(s) shall be two-speed/two winding squirrel cage type with a speed ratio of 6:1.

6. Hoisting motor(s) shall be totally enclosed with IP55 protection, minimum class F insulation, Klixon type bimetal switch for thermal protection and shall have a 60% ED rating.

7. Trolley shall be furnished with an adjustable frequency inverter drive and two-step or infinitely variable speed control for smooth acceleration and deceleration.

8. Trolley motors shall be inverter duty motors with minimum class “F” insulation and motor enclosures shall be TENV (totally enclosed non-ventilated).

9. Rotary cam type limit switch equipped with 4 micro-switches shall be provided. Limit switch shall provide upper and lower limit of hoist travel, hoist slow down prior to reaching upper limit and phase sequence supervision at upper limit. An additional block operated limit shall be included.

10. Hoist motor brake shall be DC disc type with adequate torque to stop and hold over 125% of the hoist rated load.

11. Large diameter rope drum with a minimum of 36:1 drum to wire rope diameter ratio. Groove depth shall be at least 35% of rope diameter. The rope drum shall be equipped with a rope guide to help keep the rope aligned in the grooves of the drum.

12. Wire rope shall be constructed from galvanized steel having a minimum safety factor of 5.

13. Hoist reeving shall be single reeved. Lateral hook drive shall not exceed 1/8 inch per foot of vertical travel on single reeved models.

14. The hoist nameplate is to carry a CSA c/us rating. The actual hoist control enclosure rating shall be at least equivalent to IP55/ NEMA 4 type.

15. Hooks shall be made of forged alloy steel (34CrMo4QT or 34CrNiMo6QT) and shall be fitted with a spring-loaded flipper-type safety latch.

16. Hoist shall have a duty rating suitable for the load class and load cycles of the application.

17. AGMA quality class 12 machine cut, hardened and precision ground hoist gearing. The gears inside the hoist gearboxes on models up to 5-ton capacity are lubricated by semi-fluid grease. On models over 5-ton capacity the gears inside the hoist gearbox are lubricated with semi-fluid grease or oil.

18. AGMA quality class 10, hardened and precision ground trolley drive gearing, lubricated by semi-fluid grease.

19. Trolleys shall have safety drop lugs and energy absorbing bumpers.

B. BRIDGE GIRDER

1. Bridge girder shall be per crane design.

2. Bridge girders shall be constructed from welded box girders or Structural beams, Steel, ASTM A36 or A992, as required.

C. END TRUCKS AND BRIDGE DRIVE

1. End trucks shall be designed in accordance with CMAA specifications as applicable.

2. End trucks shall be bolted to bridge girder.

3. Bridge drive shall be dual-motor (A-4 arrangement per CMAA).

4. Bridge drive shall be designed to stop the bridge within CMAA specifications.

5. End trucks shall be equipped with rail sweeps and energy-absorbing rubber bumper.

6. Travel limit switches to be provided as necessary for safe operation.

7. Bridge shall be furnished with an adjustable frequency inverter drive and two-step or infinitely variable speed control for smooth acceleration and deceleration.

8. Bridge motors shall be inverter duty motors with minimum class “F” insulation and motor enclosures shall be TENV (totally enclosed non-ventilated).

9. AGMA quality class 10, hardened and precision ground bridge drive gearing, Lubricated by semi-fluid grease.

D. POWER SUPPLY

1. Power supply for the hoist shall be as shown on the E-Sheets. All power required for the operation of the hoist, trolley and end trucks shall be developed from this source.

2. Runway electrification shall be 4-bar safety type rigid conductors as manufactured by Insul-8, Duct-O-Wire Company or Wampfler. Wall mounted disconnect switch and power to runway conductors provided by Electrical Contractor.

3. Cross bridge electrification shall be flat cable style festoon system with terminal box, multi-conductor cord, plug connectors (when available) and accessories. Cables are to be hardwired when plug connectors are not available.

E. CONTROLS

The following controls shall be used as applicable:

1. Six-way operation plug-in pushbutton pendant suspended from independent festoon track. Radio control may be quoted as an option.

2. Pendant shall include Start (momentary) button and Emergency Stop (push to maintain, turn to release) that controls a mainline contactor in the bridge control panel.

3. Pushbutton shall be clearly marked with hoist, trolley and bridge travel directions.

4. Hoist shall be 2 speed magnetic reversing type (standard) or variable frequency inverter control (optional) and the trolley and bridge controls shall be variable frequency inverter control (standard), as required per Section 1.1.B.

5. Electrical control enclosure shall be IP55 or NEMA 4 type. Pushbutton enclosure shall have a rating of IP65, NEMA 4X, 4 or 5.

F. LABELING

1. Hoist and bridge beam shall be labeled with load rating.

2. A corrosion-resistant nameplate shall be fixed to the bridge with the following information:

   a. Name of manufacturer
   b. Manufacturer's model number and serial number
   c. Capacity
   d. Date of manufacture (month and year)

G. PAINTING

1. Hoist and trolley shall be factory painted (2-part epoxy) per manufacturer's standards.

2. Bridge shall be shop cleaned, primed and painted per manufacturer's standards.

3. The following items shall not be painted:
   a. Rail surfaces in contact with wheels
   b. Wheel running surfaces
   c. Hoist wire rope
   d. Conductor bar, festoon cables and supports.

PART 3 – EXECUTION (if applicable to crane manufacturer)

3.1 INSTALLATION AND INSPECTION

A. Inspect structure and crane rail erection for conformance with reviewed shop drawings and contract documents prior to installation of equipment. Bring nonconforming work to the attention of the customer prior to proceeding with crane installation. Non-conforming runway structure or installation must be corrected prior to load testing of crane system. Costs of delays or additional work due to nonconforming runway structure will be reimbursed by the Owner.

B. Bridge crane shall be installed in conformance with manufacturer's instructions and inspected by a manufacturer's representative. Provide all necessary accessories to make bridge crane complete, usable, and capable of meeting the operating requirements specified in Operating Requirements. Test, adjust and clean equipment for acceptance by Owner.

3.2 TESTING

A. All crane equipment shall be operated through a complete list and lowering cycle and through a complete travel of the bridge and trolley to determine that the equipment shall perform smoothly and safely and that pendant cable length is sufficient to permit operation from desired floor levels. All tests shall be carried out with the bridge crane equipment loaded at 125 percent of capacity. The bridge crane provider shall provide the test weight loads. Any defects shall be corrected by the bridge crane provider without any expense to the Owner.

3.3 USE BY CONTRACTOR

A. If crane is used by the Contractor, it shall be repaired, repainted, and otherwise refurbished to like new condition prior to its acceptance. The Contractor assumes all responsibility for operation and maintenance until the crane has been accepted by the Owner.

3.4 CLEANUP

A. Upon completion of work, area shall be cleaned and restored to original condition, acceptable to the Owner.

END OF SECTION 146001

SECTION 22 0510 - BASIC PLUMBING REQUIREMENTS

PART 1 GENERAL

1.1 WORK INCLUDED

A. Provide all labor, tools, materials, accessories, parts, transportation, taxes, and related items, essential for installation of the work and necessary to make work, complete, and operational. Provide new equipment and material unless otherwise called for. References to codes, specifications and standards called for in the specification sections and on the drawings mean, the latest edition, amendment and revision of such referenced standard in effect on the date of these contract documents.

1.2 LICENSING

A. The Contractor shall hold a license to perform the work as issued by the local jurisdiction.

B. Plumbing work shall be performed by, or under, the direct supervision of a licensed master plumber if so required by the local jurisdiction.

C. The Contractor shall be responsible for reviewing the local jurisdiction requirements prior to bidding.

1.3 PERMITS

A. Apply for and obtain all required permits and inspections, pay all fees and charges including all service charges.

1.4 CODE COMPLIANCE

A. Provide work in compliance with the following:

1. The Building Code of New York State including The Fire Code; Property Maintenance Code; Plumbing Code, Mechanical Code and Fuel Gas Code; and The Energy Code of New York.

2. New York State Department of Labor Rules and Regulations.

3. Occupational Safety and Health Administration (OSHA).

4. National Fuel Gas Code, NFPA 54.

5. National Electrical Code, NFPA 70.

6. Local Codes and Ordinances.

7. Life Safety Codes, NFPA 101 (2000).

8. New York Board of Fire Underwriters.

1.5 GLOSSARY

A. ACI American Concrete Institute

B. AGA American Gas Association

C. AGCA Associated General Contractors of America, Inc.

D. AIA American Institute of Architects

E. AISC American Institute of Steel Construction

F. AFBMA Anti-Friction Bearing Manufacturer's Association

G. AMCA Air Moving and Conditioning Association, Inc.

H. ANSI American National Standards Institute

I. ARI Air Conditioning and Refrigeration Institute

J. ASHRAE American Society of Heating, Refrigeration, and Air Conditioning Engineers, Inc.

K. ASME American Society of Mechanical Engineers

L. ASPE American Society of Plumbing Engineers

M. ASTM American Society for Testing Materials

N. FM Factory Mutual Insurance Company

O. IBR Institute of Boiler & Radiation Manufacturers

P. IEEE Institute of Electrical and Electronics Engineers

Q. IRI Industrial Risk Insurers

R. NYBFU New York Board of Fire Underwriters

S. NEC National Electrical Code

T. NEMA National Electrical Manufacturer's Association

U. NESC National Electrical Safety Code

V. NFPA National Fire Protection Association

W. NYS/DEC New York State Department of Environmental Conservation

X. SBI Steel Boiler Institute

Y. SMACNA Sheet Metal and Air Conditioning Contractors National Association

Z. UFPO Underground Facilities Protective Organization

AA. UL Underwriter's Laboratories, Inc.

AB. OSHA Occupational Safety and Health Administration

AC. NYS/UFPBC New York State Uniform Fire Prevention and Building Code

1.6 DEFINITIONS

A. Acceptance — Owner acceptance of the project from Contractor upon certification by Owner's Representative.

B. Approval/Approved — Written permission to use a material or system.

C. As Called For — Materials, equipment including the execution specified/shown in the contract documents.

D. Code Requirements — Minimum requirements.

E. Concealed — Work installed in pipe and duct shafts, chases or recesses, inside walls, above ceilings, in slabs or below grade.

F. Design Equipment Substitutions. — Refer to the article, Equipment Arrangements, and the article,

G. Design Make Substitutions. — Refer to the articles, Equipment Arrangements, and the article,

H. Exposed — Work not identified as concealed.

I. Equal or Equivalent — Equally acceptable as determined by Owner's Representative.

J. Furnish — Supply and deliver to installed location.

K. Furnished by Others — Receive delivery at job site or where called for and install.

L. Inspection — Visual observations by Owner's site Representative.

M. Install — Mount and connect equipment and associated materials ready for use.

N. Labeled — Refers to classification by a standards agency.

O. Make Substitutions. — Refers to the article, Equipment Arrangements, and the article,

P. Or Approved Equal Representative. — Approved equal or equivalent as determined by Owner's

Q. Owner's Representative The Prime Professional.

R. Prime Professional Architect or Engineer having a contract directly with the Owner for professional services.

S. Provide Furnish, install, and connect ready for use.

T. Relocate Disassemble, disconnect, and transport equipment to new locations, then clean, test, and install ready for use.

U. Replace Remove and provide new item.

V. Review A general contractual conformance check of specified products.

W. Roughing Pipe, duct, conduit, equipment layout and installation.

X. Satisfactory As specified in contract documents.

Y. Site Representative Owner's inspector or "Clerk of Works" at the work site.

1.7 SHOP DRAWINGS/PRODUCT DATA/SAMPLES

A. Submit Shop Drawings on all items of equipment and materials to be furnished and installed. Submission of Shop Drawings and samples shall be accompanied by a transmittal letter, stating name of project and contractor, number of drawings, titles, and other pertinent data called for in individual sections. Shop Drawings shall be dated and contain: Name of project; name of prime professional; name of prime contractor; description or names of equipment, materials and items; and complete identification of locations at which materials or equipment are to be installed. Individual piecemeal or incomplete submittals will not be accepted. Similar items, (all types specified) shall be submitted at one time. Number each submittal by trade. Indicate deviations from contract requirements on Letter of Transmittal. Shop Drawings will be given a general review only. Corrections or comments made on the Shop Drawings during the review do not relieve Contractor from compliance with requirements of the drawings and specifications. The Contractor is responsible for: confirming and correcting all quantities; checking electrical characteristics and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner.

1.8 PROTECTION OF PERSONS AND PROPERTY

A. Contractor shall assume responsibility for construction safety at all times and provide, as part of contract, all trench or building shoring, scaffolding, shielding, dust/fume protection, mechanical/electrical protection, special grounding, safety railings, barriers, and other safety feature required to provide safe conditions for all workmen and site visitors.

1.9 EQUIPMENT ARRANGMENTS

A. The contract documents are prepared on basis of one manufacturer as "design equipment," even though other manufacturer's names are listed as acceptable makes. If Contractor elects to use one of the listed makes other than "design equipment," submit detailed drawings, indicating proposed installation of equipment. Show maintenance arrangement. Make required changes in the work of other trades, at no increase in any contract. Provide larger motors, feeders, breakers, and equipment, additional control devices, valves, fittings and other miscellaneous equipment required for proper operation, and assume responsibility for proper location of roughing and connections by other trades. Remove and replace door frames, access doors, walls, ceilings, or floors required to install other than design make equipment. If revised arrangement submittal is rejected, revise and resubmit specified "design equipment" item which conforms to contract documents.

1.10 CONTINUITY OF SERVICES

A. The building will be in use during construction operations. Maintain existing systems in operation within all rooms of building at all times. Refer to "General Conditions of the Contract for Construction" for temporary facilities for additional contract requirements. Schedules for various phases of contract work shall be coordinated with all other trades and with Owner's Representative. Provide, as part of contract, temporary mechanical and plumbing connections and relocations as required to accomplish the above. Obtain approval in writing as to date, time, and location for shutdown of existing mechanical/plumbing facilities or services.

1.11 UTILITY COMPANY SERVICES

A. Make arrangements with the Owner's Gas supplier for installation of new gas service. Coordinate all activities between the Owner and supplier. The installation of the gas service shall comply with the published standards, including but no limited to NFPA 54 and NFPA 58.

1.12 ROUGHING

A. Due to small scale of Drawings, it is not possible to indicate all offsets, fittings, changes in elevation, interferences, etc. Make necessary changes in contract work, equipment locations, etc., as part of a contract to accommodate work to obstacles and interferences encountered. Before installing, verify exact location and elevations at work site. DO NOT SCALE plans. If field conditions, details, changes in equipment or shop drawing information require an important rearrangement, report same to Owner's Representative for review. Obtain written approval for all major changes before installing.

B. Install work so that items both existing and new are operable and serviceable. Eliminate interference with removal of coils, motors, filters, belt guards and/or operation of doors. Provide easy, safe, and code mandated clearances at controllers, motor starters, valve access, and other equipment requiring maintenance and operation. Where Contractor

could not reasonably be expected to find such trade interferences due to concealment in walls, ceiling or floors, such relocations will be done by Change Order, if not, included in contract work. Contractor shall relocate existing work in way of new construction. VISIT SITE BEFORE BIDDING TO DETERMINE SCOPE OF WORK SINCE FEW OF SUCH ITEMS CAN BE SHOWN. Provide new materials, including new piping and insulation for relocated work.

C. Coordinate work with other trades and determine exact route or location of each duct, pipe, conduit, etc., before fabrication and installation. Coordinate with Architectural Drawings. Obtain from Owner's Representative exact location of all equipment in finished areas, such as thermostat, fixture, and switch mounting heights, and equipment mounting heights. Coordinate all work with the architectural reflected ceiling plans and/or existing Architecture. Mechanical and plumbing drawings show design arrangement only for diffusers, grilles, registers, air terminals, lighting fixtures, speakers, and other items. Do not rough-in contract work without reflected ceiling location plans.

D. Before roughing for equipment furnished by Owner or in other contracts, obtain from Owner and other Contractors, approved roughing drawings giving exact location for each piece of equipment. Do not "rough in" services without final layout drawings approved for construction. Cooperate with other trades to insure proper location and size of connections to insure proper functioning of all systems and equipment. For equipment and connections provided in this contract, prepare roughing drawing as follows:

    1. Existing equipment: Measure the existing equipment and prepare for installation in new location.

    2. New equipment: Obtain equipment roughing drawings and dimensions, then prepare roughing-in-drawings. If such information is not available in time, obtain an acknowledgement in writing, then make space arrangements as required with Owner's Representative.

1.13 REMOVAL WORK

A. Where existing equipment removals are called for, submit complete list to Owner's Representative all items that Owner wishes to retain that do not contain asbestos or PCB Material shall be delivered to location directed by Owner. Items that Owner does not wish to retain shall be removed from site and legally disposed of. Removal and disposal of material containing asbestos and/or PCB's shall be in accordance with Federal, State, and Local law requirements. Where equipment is called for to be relocated, contractor shall carefully remove, clean and recondition, then reinstall. Removal all abandoned piping, wiring, equipment, lighting, ductwork, tubing, supports, fixtures, etc. Visit each room, crawl space, and roof to determine the total Scope of Work. The disturbance or dislocation of asbestos-containing materials causes asbestos fibers to be released into the building's atmosphere, thereby creating a health hazard to workmen and building occupants. Consistent with Industrial Code Rule 56 and the content of recognized asbestos-control work, the Contractor shall apprise all of his workers, supervisory personnel, subcontractors, Owner and Consultants who will be at the job site of the seriousness of the hazard and of proper safeguards and work procedures which must be followed, as described in New York State Department of Labor Industrial Code Rule 56.

1.14 EQUIPMENT AND MATERIAL INSTALLATION

A. Provide materials that meet the following minimum requirements:

1. Materials shall have a flame spread rating of 25 or less and smoke developed rating of 50 or less, in accordance with NFPA 255.

2. All equipment and material for which there is a listing service shall bear a UL label.

3. Potable water systems and equipment shall be built according to AWWA Standards.

4. Gas-fired equipment and system shall meet AGA Regulations and shall have AGA label.

5. Electrical equipment and systems shall meet UL Standards and requirements of the NEC.

1.15 CUTTING AND PATCHING

A. Each trade shall include their required cutting and patching work unless shown as part of the General Construction work on the architectural drawings. Refer to "General Conditions of the Contract for Construction," for additional requirements. Cut and drill from both sides of walls and/or floors to eliminate splaying. Patch any cut or abandoned holes left by removals of equipment, fixtures, etc. Patch adjacent existing work disturbed by installation of new work including insulation, walls and wall covering, ceiling and floor covering, other finished surfaces. Patch openings and damaged areas equal to existing surface finish. Cut openings in prefabricated construction units in accordance with manufacturer's instructions.

1.16 PAINTING

A. Include painting for patchwork with color to match adjacent surfaces. Where color cannot be adequately matched, paint entire surface. Provide one (1) coat of primer and two (2) finish coats or as called for in the Specifications. Refer to Specifications for additional information.

1.17 CONCEALMENT

A. Conceal all contract work above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impractical, notify Owner's Representative before starting that part of the work and install only after his review. In areas with no ceilings, install only after Owner's Representative reviews and comments on arrangement and appearance.

1.18 CHASES

A. New Construction:

1. Certain chases, recessed, openings, shafts, and wall pockets will be provided as part of "General Building Construction Plans and Specifications." Contractor shall provide all other openings required for their contract work.

2. Check Architectural and Structural Design and Shop Drawings to verify correct size and location for all openings, recesses and chases in general building construction work.

3. Assume responsibility for correct and final location and size of such openings.

4. Rectify improperly sized, improperly located or omitted chases or openings due to faulty or late information or failure to check final location.

5. Provide 18 gauge galvanized sleeves and inserts. Extend all sleeves 2" above finished floor. Set sleeves and inserts in place ahead of new construction, securely fastened during concrete pouring. Correct, by drilling, omitted or improperly located sleeves. Assume responsibility for all work and equipment damaged during course of drilling. Firestop all unused sleeves.

6. Provide angle iron frame where openings are required for contract work.

B. In Existing Buildings:

1. Drill holes for floor and/or roof slab openings.

2. Multiple pipes smaller than 1" properly spaced and supported may pass through one 6" or smaller diameter opening.

3. Seal voids in fire rated assemblies with a fire-stopping seal system to maintain the fire resistance of the assembly. Provide 18 gauge galvanized sleeves at fire rated assemblies. Extend sleeves 2" above floors.

4. In wall openings, drill or cut holes to suit. Provide 18 gauge galvanized sleeves at shafts and fire rated assemblies. Provide fire-stopping seal between sleeves and wall in drywall construction. Provide fire-stopping similar to that for floor openings.

1.19 FLASHING, SEALING, FIRE-STOPPING

A. See Specification Section 22 0515 - Plumbing Firestopping.

1.20 SUPPORTS

A. Provide required supports, beams, angles, hangers, rods, bases, braces, and other items to properly support contract work. Supports shall meet the approval of the Owner's

Representative. Modify studs, add studs, add framing, or otherwise reinforce studs in metal stud walls and partitions as required to suit contract work. If necessary, in stud walls, provide special supports from floor to structure above. For Precast Panels/Planks and Metal Decks, support mechanical/electrical work as determined by manufacturer and Owner's Representative. Provide heavy gauge steel mounting plates for mounting contract work. Mounting plates shall span two or more studs. Size, gauge, and strength of mounting plates shall be sufficient for equipment size, weight, and desired rigidity.

1.21 ACCESS PANELS

A. Access panels shall be furnished and installed by the Contractor. Location and size shall be the responsibility of the Contractor. Bear cost of construction changes necessary due to improper information or failure to provide proper information in ample time. Access panels over 324 square inches shall have two cam locks. Contractor shall provide proper frame and door type for various wall or ceiling finishes. Access panels shall be equal to "Milcor" as manufactured by Inland Steel Products Co., Milwaukee, Wisconsin.

1.22 CONCRETE BASES

A. Provide concrete bases for all floor-mounted equipment (unless otherwise noted). Provide 3,000 lb. concrete, chamfer edges, trowel finish, and securely bond to floor by roughening slab and coating with cement grout. Bases 4" high (unless otherwise indicated); shape and size to accommodate equipment. Set anchor bolts in sleeves before pouring and after anchoring and leveling, fill equipment bases with grout.

1.23 PLUMBING EQUIPMENT CONNECTIONS

A. Contractor is responsible for draining, filling, venting, chemically treating and restarting any systems which are affected by work shown on the Contract Documents unless specifically noted otherwise.

B. Provide roughing and final water, waste, vent, propane, etc. connections to all equipment. Provide loose key stops, sanitary "P" traps, tailpiece, adapters, gas cocks, and all necessary piping and fittings from roughing point to equipment. Provide installation of sinks, faucets, traps, tailpiece furnished by others. Provide continuation of piping and connection to equipment that is furnished by others. Provide relief valve discharge piping from equipment relief valves to point(s) of safe discharge.

C. Provide as part of plumbing work valved water outlet adjacent to equipment requiring same. Provide equipment type floor drains, or drain hubs, adjacent to equipment.

D. Install controls and devices furnished by others.

E. Refer to Contract Documents for roughing schedules, and equipment lists indicating scope of connections required.

F. Provide for Owner furnished and Contractor furnished equipment all valves, piping, piping accessories, traps, pressure reducing valves, gauges, relief valves, vents, drains, insulation, sheet metal work, controls, dampers, wiring as required.

G. Refer to Manufacturer drawings and specifications for requirements of kitchen equipment, laboratory equipment and special equipment. Verify connection requirements before bidding.

1.24 STORAGE AND PROTECTION OF MATERIALS

A. Store materials on dry base, at least 6" above-ground or floor. Store so as not to interfere with other work or obstruct access to buildings or facilities. Provide waterproof/windproof covering. Remove and provide special storage for items subject to moisture damage. Protect against theft or damage from any cause. Replace items stolen or damaged, at no cost to Owner.

B. Refer to "General Conditions of the Contract for Construction."

1.25 FREEZING AND WATER DAMAGE

A. Take all necessary precautions with equipment, systems and building to prevent damage due to freezing and/or water damage. Repair or replace, at no charge in contract, any such damage to equipment, systems, and building. Perform first seasons winterizing in presence of Owner's operating staff.

1.26 OWNER INSTRUCTIONS

A. Before final acceptance of the work, furnish necessary skilled labor to operate all systems by seasons. Instruct designated person on proper operation, and care of systems/equipment. Repeat instructions, if necessary. Obtain written acknowledgement from person instructed prior to final payment. Contractor is fully responsible for system until final acceptance, even though operated by Owner's personnel, unless otherwise agreed in writing. List under clear plastic, operating, maintenance, and starting precautions procedures to be followed by Owner for operating systems and equipment.

1.27 MAINTENANCE MANUALS

A. Prepare Instructions and Maintenance Portfolios. Include one copy of each of approved Shop Drawings, wiring diagrams, piping diagrams spare parts lists, as-built drawings and manufacturer's instructions. Include typewritten instructions, describing equipment, starting/operating procedures, emergency operating instructions, summer-winter changeover, freeze protection, precautions and recommended maintenance procedures. Include name, address, and telephone number of supplier manufacturer representative and service agency for all major equipment items in a three ring binder with name of project on the cover. Deliver to Owner's Representative before request for final acceptance.

1.28 RECORD DRAWINGS

A. The Contractor shall obtain at his expense one (1) set of construction Contract Drawings including non-reproducible black and white prints and one set of reproducible for the purpose of recording record conditions.

B. The Contractor shall perform all survey work required for the location and construction of the work and to record information necessary for completion of the record drawings. Record drawings shall show the actual location of the constructed facilities in the same manner as was shown on the bid drawings. All elevations and dimensions shown on the drawings shall be verified or corrected so as to provide a complete and accurate record of the facilities as constructed.

C. It shall be the responsibility of the Contractor to mark each sheet of the non-reproducible drawings in pencil and to record thereon in a legible manner, any and all approved field changes and conditions as they occur. A complete file of approved field sketches, diagrams, and other changes shall also be maintained. At completion of the work, each sheet of record prints, plus all approved field sketches and diagrams shall be used in preparation of the reproducible record drawings.

D. Completed reproducible drawings shall be certified as reflecting record conditions and submitted to the engineer for approval.

1.29 ADDITIONAL ENGINEERING SERVICES

A. In the event that the Consultant is required to provide additional engineering services as a result of substitution of equivalent materials or equipment by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Consultant is required to examine and evaluate any changes proposed by the Contractor for the convenience of the Contractor, then the Consultant's expenses in connection with such additional services shall be paid by the Contractor and may be deducted from any monies owed to the Contractor.

1.30 FINAL INSPECTION

A. Upon completion of all punch list items, the Contractor shall provide a copy of the punch list back to the Engineer with each items noted as completed or the current status of the item. Upon receipt, the Engineer will schedule a final inspection.

1.31 ALL TRADES TEMPORARY HEAT

A. Refer to the Standard General Conditions of the contract for Construction and Supplemental General Conditions.

1.32 PLUMBING TEMPORARY FACILITIES

A. Refer to the Standard General Conditions of the Contract for Construction and Supplemental General Conditions.

1.33 CLEANING

A. It is the Contractor's responsibility to keep clean all equipment and fixtures provided under this contract for the duration of the project. Contractor shall keep the premises free from an accumulation of waste material or rubbish caused by his operations. The facilities require an environment of extreme cleanliness, and it is the Contractor's responsibility to adhere to the strict regulations regarding procedures on the existing premises. After all tests are made and installations completed satisfactorily:

B. Thoroughly clean entire installation, both exposed surfaces and interiors.

C. Remove all debris caused by work.

D. Remove tools, surplus, materials, when work is finally accepted.

END OF SECTION

SECTION 22 0515 - PLUMBING FIRESTOPPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Firestopping materials.

B. Firestopping of all penetrations, openings, and interruptions to fire rated assemblies, whether indicated on drawings or not, including but not limited to piping, tubing and similar utilities passing through or penetrating fire rated walls and floor assemblies.

1.2 RELATED SECTIONS

A. Refer to "Code Compliance Drawings" for location of fire rated assemblies. At a minimum all corridor walls and all floors between stories have a 1hour rating.

1.3 REFERENCES

A. ASTM International:

1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

B. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.

C. Underwriters Laboratories Inc.:

1. UL 263 - Fire Tests of Building Construction and Materials.

2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

3. UL 1479 - Fire Tests of Through-Penetration Firestops.

4. UL - Fire Resistance Directory.

D. Plumbing and Fuel Gas Codes of New York State.

1.4 FIRE-STOP SYSTEM PERFORMANCE REQUIREMENTS

A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration fire-stop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

1. Fire-resistance-rated walls including fire walls, fire partitions, fire barriers and smoke barriers.

2. Fire-resistance-rated horizontal assemblies including floors and ceiling membranes of roof/ceiling assemblies.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

1.6 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs which provide the specified fire ratings when tested in accordance with methods indicated.

1. Listing in the current-year classification or certification books of UL will be considered as constituting an acceptable test report.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for 3 days after installation of materials.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Hilti.

B. Nelson Fire Stop Products.

C. Specified Technology.

D. 3M Fire Protection Products.

E. Approved equals meeting UL requirements.

2.2 MATERIALS

A. Sealant Firestopping:

1. Intumescent firestop sealant designed to expand when exposed to fire.
2. Paintable
3. Fire Resistance: Up to 4 hours
4. Curing Time: 14-21 days
5. Elongation: 5%
6. Density: 1.5 g/cm3
7. Product: FS-ONE Intumescent Firestop Sealant manufactured by Hilti USA.
8. Uses: Insulated and uninsulated metal pipes, with or without sleeve and plastic pipes.

B. Silicone Sealant Firestopping:

1. Silicone based firestop sealant that provides maximum movement in fire-rated joint applications and pipe penetrations.
2. Not paintable
3. Fire Resistance: Up to 4 hours
4. Elongation: 25%
5. Product: CP 601S Elastomeric Firestop Sealant manufactured by Hilti USA.
6. Uses: Joints in walls, floor to floor or fire compartments.

C. Safing Insulation:

1. Mineral-wool type insulation.
2. Thickness: 1" to 1-1/2"
3. Density: 4 to 8 pcf
4. Product: THERMAFIBER Safing Insulation

D. Sleeves:

1. Provide sleeves as required by section 1206.4 of the Mechanical Code.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration fire-stop systems to comply with fire-stop system manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration fire-stop systems.

2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration fire-stop systems. Remove loose particles remaining from cleaning operation.

3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration fire-stop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General

1. Install materials in manner described in UL Detail and in accordance with manufacturer's instructions, completely closing openings.

B. Installation

1. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping and other items, requiring firestopping.

2. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

3. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.

4. Fire Rated Surface:

a. Seal opening at floor, wall, partition, and roof as follows:

1) Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.

2) Size sleeve allowing minimum of 1 inch void between sleeve and building element.

3) Pack void with backing material.

4) Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

b. Where plumbing piping penetrates a fire rated surface, install firestopping product in accordance with manufacturer's instructions.

5. Non-Rated Surfaces:

a. Seal opening through non-fire rated wall, floor, ceiling, and roof opening as follows:

1) Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.

2) Size sleeve allowing minimum of 1 inch void between sleeve and building element.

3) Install type of firestopping material recommended by manufacturer.

b. Install floor plates or ceiling plate where piping penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.

c. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of piping and tighten in place, in accordance with manufacturer's instructions.

C. Identification:

1. Identify through-penetration fire-stop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of edge of the fire-stop systems so that labels will be visible to anyone seeking to remove penetrating items or fire-stop systems. Use mechanical fasteners for metal labels. For plastic labels, use self-adhering type with adhesives capable of permanently bonding labels to surfaces on which labels are placed and, in combination with label material, will result in partial destruction of label if removal is attempted. Include the following information on labels:

a. The words "Warning - Through-Penetration Fire-Stop System - Do Not Disturb. Notify Building Management of Any Damage."

b. Date of installation.

c. Through-penetration fire-stop system manufacturer's name.

3.4 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration fire-stop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration fire-stop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration fire-stop systems immediately and install new materials to produce systems complying with specified requirements.

END OF SECTION

SECTION 22 0516 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Flexible pipe connectors.

1.2 RELATED REQUIREMENTS

A. Section 22 1005 - Plumbing Piping.

1.3 REFERENCE STANDARDS

A. ASTM A 269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2008.

B. EJMA (STDS) - EJMA Standards; Expansion Joint Manufacturers Association; 2003.

1.4 REGULATORY REQUIREMENTS

A. Conform to UL requirements.

PART 2 PRODUCTS

2.1 FLEXIBLE PIPE CONNECTORS - STEEL PIPING

A. Manufacturers:

1. Mercer Rubber Company: www.mercer-rubber.com.
2. Metraflex Company: www.metraflex.com.
3. Approved Equal.

B. Inner Hose: Carbon Steel.

C. Exterior Sleeve: Single braided, stainless steel.

D. Pressure Rating: 125 psi and 450 degrees F.

E. Joint: Flanged.

F. Size: Use pipe sized units.

G. Maximum offset: 3/4 inch on each side of installed center line.

2.2 FLEXIBLE PIPE CONNECTORS - COPPER PIPING

A. Manufacturer:

1. Mercer Rubber Company: www.mercer-rubber.com.

2. Metraflex Company: www.metraflex.com.

3. Approved Equal.

B. Inner Hose: Bronze.

C. Exterior Sleeve: Braided bronze.

D. Pressure Rating: 125 psi and 450 degrees F.

E. Joint: Flanged.

F. Size: Use pipe sized units.

G. Maximum offset: 3/4 inch on each side of installed center line.

H. Application: Copper piping.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install flexible pipe connectors on pipes connected to vibration isolated equipment. Provide line size flexible connectors.

C. Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

END OF SECTION

SECTION 22 0553 - PLUMBING IDENTIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Pipe Markers.

1.2 RELATED REQUIREMENTS

A. Section 22 1005 - Plumbing Piping.

1.3 REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers; 2007.

1.4 SUBMITTALS

A. Product Data: Provide manufacturers catalog literature for each product required.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Seton Identification Products.

B. Brady Corporation

C. Emed Company.

D. Approved Equal.

2.2 NAMEPLATES

A. Description: Laminated three-layer plastic with engraved letters.

1. Letter Color: White.

2. Letter Height: 3/8 inch.

3. Nameplate Height: 3/4 inch.

4. Background Color: Black.

2.3 PIPE MARKERS AND ACCESSORIES

A. Snap-on Marker: One piece wrap around type constructed of precoiled acrylic plastic with clear polyester coating, integral flow arrows, legend printed in alternating directions, 3/4 inch adhesive strip on inside edge, and 360 degree visibility.

B. Strap-on Marker: Strip type constructed of precoiled acrylic plastic polyester coating, integral flow arrows, legend printed in alternating directions, factory applied grommets, and pair of stainless steel spring fasteners.

C. Stick-on Marker: Pressure sensitive adhesive backed type constructed of vinyl with clear polyester coating, and integral flow arrows for applications where flow arrow banding tape is not being used.

D. Pipe Marker Legend:

1. Outside Diameter of Pipe or Insulation 3/4 to 1-1/4 inch:

    a. Letter size: 1/2 inch.

    b. Length of color field: 8 inches.

2. Outside Diameter of Pipe or Insulation 1-1/2 to 2 inches:

    a. Letter size: 3/4 inch.

    b. Length of color field: 8 inches.

3. Outside Diameter of Pipe or Insulation 2-1/2 to 6 inches:

    a. Letter size: 1-1/4 inch.

    b. Length of color field: 12 inches.

4. Outside Diameter of Pipe or Insulation 8 inches and greater:

    a. Letter size: 2-1/2 inch.

    b. Length of color field: 18 inches.

E. Color: Conform to ANSI A13.1.

F. Banding Tapes: Pressure sensitive adhesive backed type constructed of vinyl with clear polyester coating.

1. Plain Tape: Unprinted type; color to match pipe marker background.

2. Flow Arrow Tape: Printed type with integral flow arrows; color to match pipe marker background.

2.4 UNDERGROUND PLASTIC PIPE MARKERS

A. Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

PART 3 EXECUTION

3.1 PREPARATION

A. Complete testing, insulation, and finish painting work prior to completing the Work of this Section.

B. Clean pipe and equipment surfaces with cleaning solvents prior to installing piping identification or equipment tags.

C. Remove dust from insulation surfaces with clean clothes prior to installing piping or equipment identification.

3.2 INSTALLATION

A. Install the Work of this Section in accordance with the manufacturer's printed installation instructions, unless otherwise specified.

B. Name Plates:

1. Install plastic nameplates on properly prepared and dry surface with adhesive and ensure permanent adhesion.

C. Stick-On Pipe Markers:

1. Install minimum of 2 markers at each specified location, 90 degrees apart on visible side of pipe.

2. Encircle ends of pipe markers around pipe or insulation with banding tape with one inch lap. Use plain banding tape on markers with integral flow arrows, and flow arrow banding tape on markers without integral flow arrows.

D. Underground Plastic Pipe Markers:

1. Install 6 to 8 inches below finished grade, directly above buried pipe.

3.3 PIPING IDENTIFICATION

A. Piping Identification Types:

1. Piping or Insulation 3/4 inch and larger: Snap-on pipe markers or stick-on pipe markers.

B. Identify exposed piping, bare or insulated, as to content and direction of flow, with the following exceptions:

1. Piping in non-walk-in tunnels or underground conduits between manholes.

2. Piping in furred spaces or suspended ceilings, except at valve access panels where valves and piping shall be identified as specified for exposed piping systems.

3. Piping exposed in finished spaces such as offices, classrooms, wards, toilet rooms, shower rooms, and corridors.

C. Locate piping identification to be visible from exposed points of observation.

1. Locate piping identification at valve locations; at points where piping enters and leaves a partition, wall, floor or ceiling, and at intervals of 20 feet on straight runs.

2. Where 2 or more pipes run in parallel, place printed legend and other markers in same relative location.

3.4 EQUIPMENT IDENTIFICATION

A. Identify uninsulated plumbing equipment by means of plastic nameplates:

1. Letter Size: 3/8 inches height.

B. Small inline pumps may be identified with tags equivalent as specified for pipe service.

C. Locations: Co-locate nameplates with manufacturer's equipment nameplates where readily visible. Where view of manufacturers nameplate is obstructed locate nameplate to be readily visible.

D. Equipment Identification Legend:

1. Equipment identification shall match tags as scheduled on drawings.

END OF SECTION

SECTION 22 0719 - PLUMBING PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.2 RELATED REQUIREMENTS

A. Section 22 0515 - Plumbing Firestopping.

B. Section 22 1005 - Plumbing Piping.

1.3 REFERENCE STANDARDS

A. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2007.

B. ASTM C 177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus; 2004.

C. ASTM C 195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007.

D. ASTM C 449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007.

E. ASTM C 518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2004.

F. ASTM C 533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2009.

G. ASTM C 534/C 534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2008.

H. ASTM C 547 - Standard Specification for Mineral Fiber Pipe Insulation; 2007.

I. ASTM C 610 - Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation; 2009.

J. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2010.

K. ASTM E 96/E 96M - Standard Test Methods for Water Vapor Transmission of Materials; 2005.

L. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.

M. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than five years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum five years of documented experience.

C. Regulatory Requirements:

1. Insulation installed inside buildings, including laminated jackets, mastics, sealants and adhesives shall have a Fire Spread/Smoke Developed Rating of 25/50 or less based on ASTM E 84, NFPA 255, and UL 723.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.7 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.1 PIPING INSULATION

A. Fibrous Glass (Mineral Fiber) Insulation: Composed principally of fibers manufactured from rock, slag, or glass, with or without binders, and asbestos free.

1. Manufacturers:

a. Johns Manville Corporation.

b. Knauf Fiber Glass.

c. Owens Corning Corporation.

2. Preformed Pipe Insulation: Minimum density 3 pcf; ASTM C 547.

a. Class 1 (Suitable for Temperatures Up to 450 degrees F): 'K' value of 0.26 at 75 degrees F.

3. Premolded Fitting Insulation: Minimum density 4.0 pcf, K of 0.26 at 75 degrees F; ASTM C 547, Class 1.

4. Insulation Inserts for PVC Fitting Jackets: Minimum density 1.5 pcf, K of 0.28 at 75 degrees F; ASTM C 553, Type III.

a. Suitable for temperatures up to 450 degrees F.

B. High Density Jacketed Insulation Inserts for Hangers and Supports:

1. Manufacturers:

a. Johns Manville Corporation.

b. Knauf Fiber Glass.

c. Owens Corning Corp.

2. For Use with Fibrous Insulation:

a. Cold Service Piping:

1) Polyurethane Foam: Minimum density 4 pcf, K of 0.13 at 75 degrees F, minimum compressive strength of 125 psi.

b. Hot Service Piping:

1) Calcium Silicate: Minimum density of 15 pcf, K of 0.50 at 300 degrees F; ASTM C 610.

2) Perlite: Minimum density 12 pcf, K of 0.60 at 300 degrees F; ASTM C 610.

3. For Use with Flexible Elastomeric Foam Insulation: Hardwood dowels and blocks, length or thickness equal to insulation thickness, other dimensions as required.

C. Cements:

1. Fibrous Glass Thermal Insulating Cement: Asbestos free; ASTM C 195.

2. Fibrous Glass Hydraulic Setting Thermal Insulating and Finishing Cement: ASTM C 449/C 449M.

2.2 INSULATION JACKETS AND FITTING COVERS

A. Laminated Vapor Barrier Jackets for Piping Insulation: Factory applied by insulation manufacturer, conforming to ASTM C 1136, Type I.

1. Type I: Reinforced white kraft and aluminum foil laminate with kraft facing out.

a. Pipe Jackets: Furnished with integral 1-1/2 inch self sealing longitudinal lap, and separate 3 inch wide adhesive backed butt strips.

2. Type II: Reinforced aluminum foil and kraft laminate with foil facing out.

3. Laminated vapor barrier jackets are not required for flexible elastomeric foam insulation.

B. Canvas Jacket: Cotton duck, fire retardant, complying with NFPA 701, 4 oz/sq yd. or 6 oz/sq yd as specified.

C. Premolded PVC Fitting Jackets:

1. Constructed of high impact, UV resistant PVC.

a. ASTM D 1784, Class 14253-C.

b. Working Temperature: 0-150 degrees F.

2.3 ADHESIVES, MASTICS, AND SEALERS

A. Lagging Adhesive (Canvas Jackets): Childer's CP-50A, Epolux's Cadalag 336, Foster's 30-36.

B. Vapor Seal Adhesive (Fibrous Glass Insulation): Childers' CP-82, Epolux's Cadoprene 400, Foster's 85-75 or 85-20.

C. Vapor Barrier Mastic/Joint Sealer (Fibrous Glass Insulation): Childers' CP-30, Epolux's Cadalar 670, Foster's 95-44 or 30-35.

D. Adhesive (Flexible Elastomeric Foam): Armstrong's 520, Childers' CP-80, Epolux's Cadoprene 488, Foster's 82-40.

E. Adhesive (Reinforcing Membrane): Childers' Chil-Spray WB CP-56.

F. Mastic (Reinforcing Membrane): Childers' AK-CRYL CP-9.

G. Sealant (Metal Pipe Jacket): One-part silicone sealant for high temperatures; Dow Corning's Silastic 736 RTV or General Electric's RTV 106.

2.4 MISCELLANEOUS MATERIALS

A. Insulation Fasteners:

1. Acceptable Manufacturers: Duro-Dyne Corp.; Erico Fastening Systems, Inc.

2. Type: Weld pins, complete with self-locking insulation retaining washers.

B. Pressure Sensitive Tape for Sealing Laminated Jackets:

1. Acceptable Manufacturers: Alpha Associates, Childers, Ideal Tape, Morgan Adhesive.

2. Type: Same construction as jacket.

C. Wire, Bands, and Wire Mesh:

1. Binding and Lacing Wire: Nickel copper alloy or copper clad steel.

2. Bands: Galvanized steel, 1/2" wide x 0.015 inch thick, with 0.032 inch thick galvanized wing seals.

3. Wire Mesh: Woven 20 gage steel wire with 1 inch hexagonal openings, galvanized after weaving.

D. Reinforcing Membrane: Glass or Polyester, 10 x 10 mesh. Alpha Associates Style 59, Childers Chil-Glas, Foster's MAST-A-FAB.

PART 3 EXECUTION

3.1 PREPARATION

A. Perform the following prior to starting insulation Work:

1. Install all hangers, supports, and appurtenances in their permanent locations.

2. Complete testing of piping.

3. Clean and dry all surfaces to be insulated.

3.2 INSTALLATION, GENERAL

A. Install the Work of this Section in accordance with manufacturer's printed installation instructions unless otherwise specified.

B. Provide continuous piping insulation and jacketing when passing thru interior wall, floor, and ceiling construction.

1. At Through Penetration Firestops: Coordinate insulation densities with the requirements of approved firestop system being installed. See Section 22 0515.

    a. Insulation densities required by approved firestop system may vary with the densities specified in this Section. When this occurs use the higher density insulation.

C. Individual piping runs shall have consistent insulation type.

D. Apply Insulation to completely cover entire surface of piping. Do not insulate over weld certification stamps.

3.3 INSTALLATION AT HANGERS AND SUPPORTS

A. Reset and realign hangers and supports if they are displaced during insulation installation.

B. Install high density jacketed insulation inserts at hangers and supports for insulated piping as specified.

1. Insulation Inserts For Use with Fibrous Glass Insulation:

    a. Where clevis hangers are used, install insulation shields and high density jacketed insulation inserts between shield and pipe.

    b. Where insulation is subject to compression at points over 180 degrees apart, e.g. riser clamps, U-bolts, or trapezes, fully encircle pipe with 2 protection shields and 2 high density jacketed fibrous glass insulation inserts within supporting members.

        1) Exception: Locations where pipe covering protection saddles are specified for hot service piping, 6 inch and larger.

2. Insulation Inserts For Use with Flexible Elastomeric Foam Insulation:

    a. Where clevis hangers are used, install insulation shields with hardwood filler pieces, same thickness as adjoining insulation, inserted in undersized die cut or slotted holes in insulation at support points.

    b. Where hardwood blocks are used, contour to match the curvature of pipe, and shield.

    c. Coat dowels and blocks with insulation adhesive, and insert while sill wet.

    d. Vapor seal outer surfaces of dowels and blocks with adhesive after insertion.

    e. Provide minimum 2 dowels plugs or one filler block per hanger.

3.4 INSTALLATION OF FIBROUS GLASS COLD SERVICE INSULATION

A. Install insulation materials with a field or factory applied ASTM C 1136 Type I laminated vapor barrier jacket, unless otherwise specified.

B. Piping:

1. Butt insulation joints together.

2. Continuously seal joints with minimum 1-1/2 inch wide self-sealing longitudinal jacket laps and 3-inch wide butt adhesive backed strips, or 3 inch wide pressure sensitive sealing tape of same material as jacket.

3. Bed insulation in a 2-inch wide band of vapor barrier mastic,and vapor seal exposed ends of insulation with vapor barrier mastic at each butt joint between pipe insulation and equipment, fittings or flanges at the following intervals:

    a. Horizontal Pipe Runs: 21 ft.

    b. Vertical Pipe Runs: 9 ft.

C. Fittings, Valves, Flanges and Irregular Surfaces:

1. Insulate with mitre cut or pre-molded fitting insulation of same material and thickness as adjoining pipe insulation.

2. Secure insulation in place with 16 gage wire, with ends twisted and turned down into insulation.

3. Butt fitting, valve, and flange insulation against pipe insulation and bond with insulating cement.

4. Insulate valves up to and including bonnets, without interfering with packing nuts.

5. Apply leveling coat of insulating cement to smooth out insulation and cover wiring.

6. When insulating cement has dried, seal fitting, valve and flange insulation by embedding a layer of reinforcing membrane of 4 oz. canvas jacket between 2 flood coats of vapor barrier mastic, each 1/8 inch thick wet.

7. Lap reinforcing membrane or canvas on itself and adjoining pipe insulation at least 2 inches.

8. Trowel, brush, or rubber glove outside coat over entire insulated surface.

D. Fittings, Valves, Flanges and Irregular Surfaces - Alternate:

1. Apply one piece pre-molded PVC fitting covers with fibrous glass insulation inserts with galvanized coated tack fasteners. Tape circumferential joint between

insulation and premolded fitting cover with 2 inch wide pressure sensitive polyvinyl tape.

a. Exception: Provide additional insulation inserts on service operating at under 45 degrees F or where insulation thickness exceeds 1-1/2 inches. Ensure that insulation is adequate to prevent PVC fitting jacket temperature from falling below 45 degrees F.

3.5 INSTALLATION OF FIBROUS GLASS HOT SERVICE INSULATION

A. Install insulation materials with field or factory applied ASTM C 1136 Type I laminated vapor barrier jacket unless otherwise specified.

B. Canvas Jackets on Piping, Fittings, Valves, Flanges, Unions, and Irregular Surfaces:

1. For piping 2 inch size and smaller: 4 oz per sq yd unless otherwise specified.

2. For piping over 2 inch size: 6 oz per sq yd unless otherwise specified.

C. Piping:

1. Butt insulation joints together.

2. Continuously seal joints with minimum 1-1/2 inch wide self-sealing longitudinal jacket laps and 3-inch wide butt adhesive backed strips, or 3 inch wide pressure sensitive sealing tape of same material as jacket.

3. Fill voids in insulation at hanger with insulating cement.

4. Exceptions:

a. Piping in Accessible Shafts, Attic Spaces, Crawl Spaces, Unfinished Spaces, and Concealed Piping: Butt insulation joints together and secure with minimum 1-1/2" wide longitudinal jacket laps and 3 inch wide butt strips of same material as jacket, with outward clinching staples on maximum 4 inch centers. Fill voids in insulation at hangers with insulating cement.

b. Piping in Tunnels: Butt insulation joints together and secure with minimum 1-1/2" wide longitudinal jacket laps and 3 inch wide butt strips, of same material as jacket, with outward clinching staples on maximum 4 inch centers and 16 gage wires a minimum of 4 loops per section. Fill voids in insulation with insulating cement.

5. Fittings, Valves, Flanges and Irregular Surfaces:

a. Insulate with mitre cut or pre-molded fitting insulation of same material and thickness as adjoining pipe insulation.

b. Secure insulation in place with 16 gage wire, with ends twisted and turned down into insulation.

c. Butt fitting, valve, and flange insulation against pipe insulation and bond with insulating cement.

d. Insulate valves up to and including bonnets, without interfering with packing nuts.

e. Apply leveling coat of insulating cement to smooth out insulation and cover wiring.

f. When insulating cement has dried, coat insulated surface with lagging adhesive, and apply 4 oz. or 6 oz. canvas jacket as required by pipe size.

1) Lap canvas jacket on itself and adjoining pipe insulation at least 2 inches.

2) Size entire canvas jacket with lagging adhesive.

g. Exceptions:

1) Insulate fittings, valves, and irregular surfaces 3 inch size and smaller with insulating cement covered with 4 oz or 6 oz canvas jacket as required by pipe size. Terminate pipe insulation adjacent to flanges and unions with insulating cement, troweled down to pipe on a bevel.

2) Sizing of canvas surface is not required on fittings, valves, flanges, and irregular surfaces in concealed piping, piping in accessible shafts, attic spaces, crawl spaces, unfinished spaces, and tunnels.

6. Fittings, Valves, Flanges and Irregular Surfaces - Alternate:

a. Apply one piece pre-molded PVC fitting covers with fibrous glass insulation inserts with galvanized coated tack fasteners. Tape circumferential joint between insulation and premolded fitting cover with 2 inch wide pressure sensitive polyvinyl tape.

1) Exception: Provide additional insulation inserts on service operating at over 250 degrees F or where insulation thickness exceeds 1-1/2 inches. Ensure that insulation is adequate to prevent PVC fitting jacket temperature from exceeding 150 degrees F.

3.6 SCHEDULE OF PIPING INSULATION

A. Insulate all cold service and hot service piping, and appurtenances except where otherwise specified.

B. Plumbing Piping Systems:

1. Domestic Hot Water Supply (105 to 140 degrees F):

a. Glass Fiber Insulation:

1) Pipe Size Range: Up to 1-1/2 inch.

(a) Thickness: 1 inch.

2) Pipe Size Range: Over 1-1/2 inch.

(a) Thickness: 2 inch.

2. Domestic Hot Water Recirculation:

a. Glass Fiber Insulation:

1) Pipe Size Range: All sizes.

(a) Thickness: 1 inch.

3. Tempered Domestic Water Supply:

a. Glass Fiber Insulation:

1) Pipe Size Range: Up to 1-1/2 inch.

(a) Thickness: 1 inch.

2) Pipe Size Range: Over 1-1/2 inch.

(a) Thickness: 2 inch.

4. Tempered Domestic Water Recirculation:

a. Glass Fiber Insulation:

1) Pipe Size Range: All sizes.

(a) Thickness: 1 inch.

5. Domestic and non-potable Cold Water:

a. Glass Fiber Insulation:

1) Pipe Size Range: All sizes.

(a) Thickness: 3/4 inch.

C. Schedule of Items Not to be Insulated:

1. Chrome plated piping, unless otherwise specified.

2. Water heater blow-off piping.

3. Air vents, pressure reducing valves, pilot lines, safety valves, relief valves.

4. Water meters.

3.7 PIPING INSULATION SCHEDULE

A. The following insulation and jacket types are referenced in the insulation schedule:

1. Insulation Types

Type	Description
1	Glass fiber
2	Elastomeric
3	Cellular glass
4	Mineral fiber
5	Polyethylene

2. Jacket Types

Type	Description
A	All service jacket
B	All service jacket with vapor barrier
C	PVC jacket
D	Aluminum jacket
E	Canvas jacket

B. Insulation Schedule – Provide insulation types and thickness as indicated in table below.

Piping Systems	Pipe Size (inches)	Insulation Type	Jacket Type	Insulation Thickness
Plumbing				
Tempered water	All	1	A and C(1)	1” minimum
Potable water - cold	All	1	B and C(1)	3/4” minimum
Potable water - hot	All	1	A and C(1)	1” minimum

1. (1) PVC jacket required for piping in process mechanical areas (Thickening Room, Chemical Rooms, RAS Pump Room, Cassette Laydown Area, Mechanical Operations Room, Dewatering Building Lower Level, etc.). Not required for piping above suspended ceilings and inside pipe chases. In mechanical rooms (i.e., boiler rooms), electrical room, and storage room painted canvas jacket is acceptable.

END OF SECTION

SECTION 22 1005 - PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe, pipe fittings, valves, and connections for piping systems.

1. Sanitary sewer.

2. Domestic water

3. Gas.

1.2 RELATED REQUIREMENTS

A. Section 09 9000 - Painting and Coating.

B. Section 22 0515 - Plumbing Firestopping.

C. Section 22 0553 - Plumbing Identification.

D. Section 22 0719 - Plumbing Piping Insulation.

1.3 SUBMITTALS

A. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with State of New York, standards.

1. Maintain one copy on project site.

B. Valves: Manufacturer's name and pressure rating marked on valve body.

C. Welding Materials and Procedures: Conform to ASME (BPV IX) and applicable state labor regulations.

D. Welder Qualifications: Certified in accordance with ASME (BPV IX).

E. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.5 REGULATORY REQUIREMENTS

A. Perform Work in accordance with State of New York plumbing code.

B. Conform to applicable code for installation of backflow prevention devices.

C. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.7 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

1.8 GENERAL REQUIREMENTS

A. Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

PART 2 PRODUCTS

2.1 SANITARY SEWER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Pipe: ASTM A 74 service weight.

1. Fittings: Cast iron.

2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C 564 neoprene gaskets.

B. PVC Pipe: ASTM D 2665 or ASTM D 3034.

1. Fittings: PVC.

2. Joints: Solvent welded, with ASTM D 2564 solvent cement.

2.2 SANITARY SEWER PIPING, ABOVE GRADE

A. Cast Iron Pipe: ASTM A 74, service weight.

1. Fittings: Cast iron.

2. Joint Seals: ASTM C 564 neoprene gaskets.

B. Cast Iron Pipe: CISPI 301, hubless, service weight.

1. Fittings: Cast iron.

2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

C. PVC Pipe: ASTM D 2665.

1. Fittings: PVC.

2. Joints: Solvent welded, with ASTM D 2564 solvent cement.

2.3 WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Copper Pipe: ASTM B 42, hard drawn.

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.

2. Joints: ASTM B 32, alloy Sn95 solder.

2.4 POTABLE WATER PIPING, ABOVE GRADE

A. Copper Tube: ASTM B 88 (ASTM B 88M), Type L (B), Drawn (H).

1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.

2. Joints: ASTM B 32, alloy Sn95 solder.

B. CPVC Pipe: ASTM D 2846/D 2846M, ASTM F 441/F 441M, or ASTM F 442/F 442M.

1. Fittings: CPVC; ASTM D 2846/D 2846M, ASTM F 437, ASTM F 438, or ASTM F 439.

2. Joints: ASTM D 2846/D 2846M, solvent weld with ASTM F 493 solvent cement.

2.5 PROPANE GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Steel Pipe: ASTM A 53/A 53M Schedule 40 black.

1. Fittings: ASTM A 234/A 234M, wrought steel welding type, with AWWA C105/A21.5 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

2. Joints: ASME B31.1, welded.

2.6 PROPANE GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A 53/A 53M Schedule 40 black.

1. Fittings: ASME B16.3, malleable iron, or ASTM A 234/A 234M, wrought steel welding type.

2. Joints: NFPA 58, threaded or welded to ASME B31.1.

2.7 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Ferrous Pipe Sizes 3 Inches and Under:

1. Class 150 malleable iron threaded unions.

B. Unions for Copper Tube and Pipe 2 Inches and Under:

1. Class 150 bronze unions with soldered joints.

C. Flanges for Pipe Size Over 1 Inch:

1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.

2. Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.8 PIPE HANGERS AND SUPPORTS

A. All plumbing piping shall be supported in accordance with the Plumbing Code of New York State. Hangers, anchors and supports shall support the piping and the contents of the piping. Hangers and strapping shall be of approved material that will not promote galvanic action.

B. Plumbing Piping - Drain, Waste, and Vent:

1. Conform to ASME B31.9.

2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.

3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.

4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.

7. Vertical Support: Steel riser clamp.

8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

C. Plumbing Piping - Water:

1. Conform to ASME B31.9.

2. Hangers for Pipe Sizes 1/2 Inch to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.

3. Hangers for Cold Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.

4. Hangers for Hot Pipe Sizes 2 Inches to 4 Inches: Carbon steel, adjustable, clevis.

5. Multiple or Trapeze Hangers: Steel channels with welded supports or spacers and hanger rods.

6. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

7. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.

8. Vertical Support: Steel riser clamp.

9. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

10. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.

11. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.9 GATE VALVES

A. Manufacturers:

1. Conbraco Industries: www.conbraco.com.

2. Nibco, Inc: www.nibco.com.

3. Milwaukee Valve Company: www.milwaukeevalve.com.

4. Approved Equal.

B. Up To and Including 3 Inches:

1. MSS SP-80, Class 125, bronze body, bronze trim, rising stem, handwheel, inside screw, solid wedge disc, solder ends.

C. 2 Inches and Larger:

1. MSS SP-70, Class 125, iron body, bronze trim, outside screw and yoke, handwheel, solid wedge disc, flanged ends. Provide chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

2.10 GLOBE VALVES

A. Manufacturers:

1. Conbraco Industries: www.conbraco.com.

2. Nibco, Inc: www.nibco.com.

3. Milwaukee Valve Company: www.milwaukeevalve.com.

4. Substitutions: See Section 01 6000 - Product Requirements.

B. Up To and Including 3 Inches:

1. MSS SP-80, Class 125, bronze body, bronze trim, handwheel, bronze disc, solder ends.

C. 2 Inches and Larger:

1. MSS SP-85, Class 125, iron body, bronze trim, handwheel, outside screw and yoke, renewable bronze plug-type disc, renewable seat, flanged ends. Provide chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

2.11 BALL VALVES

A. Manufacturers:

1. Conbraco Industries: www.conbraco.com.

2. Nibco, Inc: www.nibco.com.

3. Milwaukee Valve Company: www.milwaukeevalve.com.

4. Approved Equal.

B. Construction, 4 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze, two piece body, chrome plated brass ball, full port, teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder ends with union.

2.12 PLUG VALVES

A. Manufacturers:

1. Conbraco Industries.
2. Homestead Valve.
3. Nordstrom.
4. Approved Equal.

B. Construction 2 inches and Less: 100 psig WOG, gas cock type with cast iron or bronze body, bronze plug, square head, wrench operator, and threaded ends.

C. Construction 2-1/2 inches and Larger: 200 psig WOG, lubricated type with standard port opening, cast iron or semi-steel body, sealed lubrication system with lubricant fitting and dial indicator, cylindrical plug or teflon tapered plug, lubricant grooves in body or plug, flanged ends, and capable of lubrication with valve under pressure and plug in any position. Wrench operator.

2.13 BUTTERFLY VALVES

A. Manufacturers:

1. Hammond Valve: www.hammondvalve.com.
2. Crane Co.: www.cranevalve.com.
3. Milwaukee Valve Company: www.milwaukeevalve.com.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Construction 1-1/2 Inches and Larger: MSS SP-67, 200 psi CWP, cast or ductile iron body, nickel-plated ductile iron disc, resilient replaceable EPDM seat, wafer ends, extended neck, 10 position lever handle.

C. Provide gear operators for valves 8 inches and larger, and chain-wheel operators for valves mounted over 8 feet above floor.

2.14 SOLENOID VALVES

A. Manufacturers:

1. ASCO Valve, Inc.: www.ascovalve.com

2. Substitutions: See Section 01 6000 - Product Requirements.

B. Water service.

1. Model 8221 series; Slow closing to protect system from water hammer.

2. Construction: Brass body with stainless steel core and springs; NBR or PTFE seals and disks. Provide watertight solenoid enclosure.

3. Normally closed (Closed when de-energized).

C. Combustion (Fuel gas) service.

1. Model: 8040 series.

2. Construction: Aluminum body with stainless steel core and springs; NBR seals and disk. Provide watertight solenoid enclosure.

3. Normally closed (Closed when de-energized).

2.15 SWING CHECK VALVES

A. Manufacturers:

1. Hammond Valve: www.hammondvalve.com.

2. Nibco, Inc: www.nibco.com.

3. Milwaukee Valve Company: www.milwaukeevalve.com.

4. Approved Equal.

B. Up to 2 Inches:

1. MSS SP-80, Class 125, bronze body and cap, bronze swing disc with rubber seat, solder ends.

C. Over 2 Inches:

1. MSS SP-71, Class 125, iron body, bronze swing disc, renewable disc seal and seat, flanged or grooved ends.

2.16 SPRING LOADED CHECK VALVES

A. Manufacturers:

1. Hammond Valve: www.hammondvalve.com.

2. Crane Co.: www.cranevalve.com.

3. Milwaukee Valve Company: www.milwaukeevalve.com.

4. Approved Eqaul.

B. Class 125, iron body, bronze trim, stainless steel springs, bronze disc, Buna N seals, wafer style ends.

2.17 WATER PRESSURE REDUCING VALVES

A. Manufacturers:

1. Amtrol Inc: www.amtrol.com.

2. Cla-Val Co: www.cla-val.com.

3. Watts Regulator Company: www.wattsregulator.com.

4. Approved Equal.

B. Up to 2 Inches:

1. MSS SP-80, bronze body, stainless steel and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded single union ends.

C. Over 2 Inches:

1. MSS SP-85, cast iron body, bronze fitted, elastomeric diaphragm and seat disc, flanged.

2.18 RELIEF VALVES

A. Pressure Relief:

1. Manufacturers:

a. Cla-Val Co: www.cla-val.com.

b. Henry Technologies: www.henrytech.com.

c. Watts Regulator Company: www.wattsregulator.com.

d. Approved Equal.

2. AGA Z21.22 certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.

B. Temperature and Pressure Relief:

1. Manufacturers:

a. Cla-Val Co: www.cla-val.com.

b. Henry Technologies: www.henrytech.com.

c. Watts Regulator Company: www.wattsregulator.com.

d. Approved Equal.

2. AGA Z21.22 certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME (BPV IV) certified and labelled.

2.19 STRAINERS

A. Manufacturers:

1. Armstrong International, Inc: www.armstronginternational.com.

2. Green Country Filtration: greencountryfiltration.com.

3. WEAMCO: www.weamco.com.

4. Approved Equal.

B. Size 2 inch and Under:

1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.

2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.

C. Size 1-1/2 inch to 4 inch:

1. Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.

2.20 PIPING SCHEDULE

A. Provide piping in accordance with the following schedule or as otherwise noted on the Drawings:

Application (Dry Areas)	Sizes	Pipe	Joint
Domestic hot, tempered, and cold potable water	3” or less	L copper	Soldered
Domestic hot, tempered, and cold potable water	Above 3"	Ductile iron	Flanged
Application (Wet Process Mechanical Areas)	Sizes	Pipe	Joint
Domestic hot, tempered, and cold potable water	3” or less	CPVC Schedule 80	Solvent

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 0719.

H. Provide access where valves and fittings are not exposed.

I. Install vent piping penetrating roofed areas to maintain integrity of roof assembly. Terminate at least 18 inches above roof.

J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

K. Provide support for utility meters in accordance with requirements of utility companies.

L. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.

M. Install valves with stems upright or horizontal, not inverted.

N. Use non-hardening pipe dope on gas piping threads, do not use thread seal tape.

O. PVC Pipe: Make solvent-welded joints in accordance with ASTM D 2855.

P. Sleeve pipes passing through partitions, walls and floors.

Q. Inserts:

1. Provide inserts for placement in concrete formwork.

2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

R. Pipe Hangers and Supports:

1. Support horizontal piping as scheduled.

2. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

3. Place hangers within 12 inches of each horizontal elbow.

4. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

5. Support vertical piping as scheduled.

6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

7. Provide copper plated hangers and supports for copper piping.

8. Prime coat exposed steel hangers and supports. Refer to Section 09 9000. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.3 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

C. Install gate or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

D. Install globe valves for throttling, bypass, or manual flow control services.

E. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.

3.4 TOLERANCES

A. Drainage Piping: Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/4 inch per foot slope for pipes 2-1/2" diameter and less, 1/8 inch per foot slope for pipes 3" to 6" in diameter and 1/16 inch per foot slope for pipes 8" and larger in diameter.

B. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points with capped drain valves.

3.5 TESTING AND INSPECTIONS

A. New plumbing systems and parts of existing systems that have been altered, extended or repaired shall be tested in accordance with the Plumbing Code of New York State or the authority having jurisdiction to disclose leaks and defects.

B. New plumbing systems shall conform to NSF 61 and NSF 372 and shall be "lead-free".

C. Pressure test piping systems inside buildings, at the roughing-in stage of installation, before piping is enclosed by construction Work, and at other times as directed. Perform test operations in sections as required and directed, to progress the Work in a satisfactory manner and not delay the general construction of the building. Valve or cap-off sections of piping to be tested, utilizing valves required to be installed in the permanent piping systems, or temporary valves or caps as required to perform the Work.

D. The contractor shall make the applicable tests prescribed below to determine compliance with the provisions of the Plumbing Code of New York State. The contractor shall give reasonable advance notice to the code officail when the plumbing work is ready for tests. The equipment, material, power and labor necessary for the inspection and test shall be furnished by the contractor. All plumbing system piping shall be tested with either water or air. Plastic piping shall not be tested with air.

E. Piping shall be tight under test and shall not show loss in pressure or visible leaks, during test operations or after the minimum duration of time as specified. Remove piping which is not tight under test; remake joints and repeat test until no leaks occur.

F. Required Inspections:

1. Underground inspection shall be made after trenches or ditches are excavated and bedded, piping installed, and before any backfill is put in place.

2. Rough-in inspection shall be made of completed portions of all sanitary, storm and water distribution piping, after the framing, fireblocking, firestopping, draft-stopping and bracing for that portion is in place, and prior to the installation of wall or ceiling membranes.

3. Final inspection shall be made after the building is completed, all plumbing fixtures are in place and properly connected, and the structure is ready for occupancy.

G. Drainage and Vent Water Test:

1. A water test shall be applied to the drainage system either in its entirety or in sections. If applied to the entire system, all openings in the piping shall be tightly closed, except highest opening, and the system shall be filled with water to the point of overflow. If the system is tested in sections, each opening shall be tightly plugged except the highest openings of the section under test, and each section filled with water, but no section shall be tested with less than a 10-foot head of water. In testing successive sections, at least the upper 10-foot of the next proceeding section shall be tested so that no joint or pipe in the building, except the uppermost 10 feet of the system, shall have been submitted to a test of at least 10-foot head of water. Test by filling the entire system with water, and allowing to stand for 3 hours, with no noticeable loss of water.

H. Drainage and Vent Air Test:

1. An air test shall be made by forcing air into the system until there is a uniform gauge pressure of 5 pounds per square inch (psi) or sufficient to balance a 10-inch column of mercury. This pressure shall be held for a test period of 3 hours with no noticeable loss. Any adjustments to the test pressure required because of changes in ambient temperature or the seating of gaskets shall be made prior to the beginning of the test period.

I. Drainage and Vent Final Test:

1. After the plumbing fixtures have been set and their traps filled with water, the entire drainage system shall be submitted to final tests. The final test shall be visual and in sufficient detail to determine compliance with the provisions of the Plumbing Code of New York State.

J. Domestic Water (Potable Cold, Domestic Hot and Recirculation) Inside Buildings:

1. Before fixtures, faucets, trim and accessories are connected, perform hydrostatic test at 125 psig minimum for 4 hours.

2. After fixtures, faucets, trim and accessories are connected, perform hydrostatic retest at 75 psig for 4 hours.

3. The water utilized for the tests shall be obtained from a potable water source of supply.

K. Forced Sewer Test:

1. Forced sewer tests shall consist of plugging the end of the building sewer at the point of connection with the public sewer and applying a pressure of 5 psi

greater than the pump rating, and maintaining such pressure for 3 hours with no noticeable loss.

L. Gas Piping:

1. Before backfilling or concealment perform air test of duration and pressure as required by the local gas company. However, for gas piping designed for pressures of from 4 inches to 6 inches water column, air test at 15 inches Hg for one hour, without drop in pressure. Test gas piping with air only. Check joints for leaks with soap suds.

M. Inspection and Testing of Backflow Prevention Assemblies:

1. Backflow prevention assemblies shall be tested at the time of installation and immediately after repairs or relocation.

2. The testing procedure shall be performed in accordance with one of the following standards:

a. ASSE Series 5000 - Standards 5013, 5015, 5020, 5047, 5052 or 5056.

3.6 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. New and repaired potable water systems shall be purged of deleterious matter and disinfected prior to utilization.

B. The method to be followed for the disinfection of potable water systems shall be in accordance with the applicable NYSDOH Regulations.

1. Completely fill the piping, including water storage equipment if installed, with a water solution containing 50 mg/l available chlorine and allow to stand for 24 hours. Operate all valves during this period to ensure their proper disinfection. After the 24 hour period, the chlorine residual shall be 25 mg/l or greater. If not, flush and repeat chlorination procedure.

2. After the retention period, discharge the solution into an approved waste and flush the system thoroughly with potable water until substantially all traces of chlorine are removed. Drain and flush water storage equipment if installed.

3.7 SERVICE CONNECTIONS

A. Provide new sanitary sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

B. Provide new water service complete with approved backflow preventer and water meter with by-pass valves, pressure reducing valve.

1. Provide sleeve in wall for service main and support at wall with reinforced concrete bridge. Calk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.

2. Provide 18 gage galvanized sheet metal sleeve around service main to 6 inch above floor and 6 feet minimum below grade. Size for minimum of 2 inches of loose batt insulation stuffing.

C. Coordinate new gas service complete with gas meter and regulators with local utility. Provide regulators on each line serving gravity type appliances, sized in accordance with equipment.

3.8 SCHEDULES

A. Pipe Hanger Spacing.

1. Cast Iron Piping

a. All Sizes:

1) Maximum Horizontal Spacing: 5 ft. (May be increased to 10 ft. where 10-foot pipe lengths are installed.)

2) Maximum Vertical Spacing: 15 ft.

2. Copper or Copper-Alloy Tubing.

a. 1-1/4" diameter and smaller:

1) Maximum Horizontal Spacing: 6 ft.

2) Maximum Vertical Spacing: 10 ft.

b. 1-1/2" diameter and larger:

1) Maximum Horizontal Spacing: 10 ft.

2) Maximum Vertical Spacing: 10 ft.

3. CPVC Pipe or Tubing.

a. 1" diameter and smaller:

1) Maximum Horizontal Spacing: 3 ft.

2) Maximum Vertical Spacing: 10 ft. (midstory guide for sizes 2" and smaller)

b. 1-1/4" diameter and larger:

1) Maximum Horizontal Spacing: 4 ft.

2) Maximum Vertical Spacing: 10 ft. (midstory guide for sizes 2" and smaller)

4. Steel Pipe.

a. All Sizes:

1) Maximum Horizontal Spacing: 12 ft.

2) Maximum Vertical Spacing: 15 ft.

B. The materials of construction for all hangers and supports shall be stainless steel in accordance with the following: Any exterior area or any interior process area that has a process mechanical environmet that is corrosive, wet, or hazardous environment.

END OF SECTION

SECTION 22 1006 - PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Drains.

B. Cleanouts.

C. Hydrants.

D. Backwater valves.

E. Backflow preventers.

F. Water hammer arrestors.

G. Mixing valves.

H. Relief valves.

I. Air vents.

J. Floor drain trap seals.

1.2 RELATED REQUIREMENTS

A. Section 22 1005 - Plumbing Piping.

B. Section 22 3000 - Plumbing Equipment.

C. Section 22 4000 - Plumbing Fixtures.

1.3 REFERENCE STANDARDS

A. ASME A112.6.3 - Floor and Trench Drains; 2001 (R2007).

B. ASSE 1013 - Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers; 2011.

C. ASSE 1017 - Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems; 2023.

D. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance; 2011.

E. NSF 61 - Drinking Water System Components - Health Effects; 2014 (Errata 2015).

F. NSF 372 - Drinking Water System Components - Lead Content; 2011.

G. PDI-WH 201 - Water Hammer Arresters; 2010.

1.4 SUBMITTALS

A. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.2 DRAINS

A. Floor Drain:

1. ASME A112.6.3; lacquered cast iron or stainless steel epoxy coated, two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.

2.3 CLEANOUTS

A. Cleanouts at Exterior Surfaced Areas:

1. Round cast nickel bronze access frame and non-skid cover.

B. Cleanouts at Exterior Unsurfaced Areas:

1. Line type with lacquered cast iron body and round epoxy coated gasketed cover.

C. Cleanouts at Interior Finished Floor Areas:

1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.

D. Cleanouts at Interior Finished Wall Areas:

1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with machine screw.

E. Cleanouts at Interior Unfinished Accessible Areas: Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.4 HYDRANTS

A. Wall Hydrants:

1. ASSE 1019, freeze resistant, self-draining, hose thread spout, and integral vacuum breaker.

2.5 BACKWATER VALVES

A. Plastic Backwater Valves: PVC body and valve, extension sleeve, and access cover.

2.6 BACKFLOW PREVENTERS

A. Reduced Pressure Backflow Preventer Assembly:

1. ASSE 1013; low-lead cast bronze body and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve that opens under back pressure in case of diaphragm failure, and non-threaded vent outlet.

2.7 WATER HAMMER ARRESTORS

A. Water Hammer Arrestors:

1. Copper construction, bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range minus 100 to 300 degrees F and maximum 250 psi working pressure.

2.8 MIXING VALVES

A. Thermostatic Master Mixing Valves:

1. Valve: ASSE 1017, bronze or brass body; thermostatic element; corrosion- and lime-resistant internal components; integral locking temperature adjustment.

2. Accessories:

a. Strainer stop checks on inlets.

b. Shut-off valve on outlet.

c. Stem thermometer on outlet.

d. Strainer stop checks on inlets.

3. Cabinet: 16 gauge, 0.0598 inch stainless steel, for surface mounting with keyed lock.

2.9 RELIEF VALVES

A. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

2.10 AIR VENTS

A. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8 inch brass needle valve at top of chamber.

B. Float Type:

1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

2. Cast iron body and cover, float, bronze pilot valve mechanism suitable for system operating temperature and pressure; with isolating valve.

C. Washer Type:

1. Brass with hygroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring loaded ball check valve.

2.11 FLOOR DRAIN TRAP SEALS

A. Description: Push-fit EPDM or silicone fitting with a one-way membrane.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

C. Encase exterior cleanouts in concrete flush with grade.

D. Install floor cleanouts at elevation to accommodate finished floor.

E. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibbs, process mechanical equipment, etc.

F. Pipe relief from backflow preventer out exterior wall or to nearest floor drain.

G. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to longest length lines, and wherever necessary.

END OF SECTION

SECTION 221319.13 – SANITARY TRENCH DRAIN

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Precast Trench Drain 4" ID w Ductile Iron Longitudinally Slotted Grates

1.2 SYSTEM COMPONENTS

A. Precast Trench Drain

1. The precast trench shall be manufactured using polyester polymer concrete with the following material properties when tested:

Property	**Test Method**	**Value**
Compressive Strength	ASTM C579	14,000 psi Minimum
Bending Strength	ASTM C580	4,000 psi Minimum
Tensile Strength	ASTM C307	2,000 psi Minimum
Moisture Absorption	ASTM D570	0.1% Maximum
Chemical Resistance	ASTM C267	Pass
Freeze/Thaw w/o weight loss	ASTM C666	1,600 Number of Cycles Minimum
Resistance to Fungi	ASTM G21	Zero (0) Rating Mold Growth
UL/ULC Listed- Flame Spread	UL-723	Class A

2. The trench consisting of 39.19” (1 meter) or 19.56” (1/2 meter) channels with nominal 6” (155mm) outside width, 4 “ (100mm) inside width.

3. Pre-sloped channels shall have a standard slope of 0.6% with radius bottom. Non-sloping channels must have written approval by engineer prior to installation.

4. Channels shall have tongue and groove joints. Grate lock down slots shall have polyethylene vibration dampening inserts. All channels must have full length anchoring ribs for a positive mechanical lock with the surrounding concrete.

B. Sidewall Extensions

1. Sidewall extensions for channels may be used for hydraulic performance or to maintain the standard slope of 0.6% in greater trench run lengths.

2. Sidewall extensions shall be composed of similar material and thickness as the channels and shall have tongue and groove joints.

C. Grating

1. Black polymer coated ductile iron conforming to ASTM A-536 longitudinally slotted with a minimum of 0.17Ft2 /L Ft (.052m^2/Lm) open area.
2. Grates shall meet a minimum 1235 psi proof load per AASHTO M-306 test modified by utilizing a 9” x 3” load plate. Grates shall seat into channels without rocking and shall be locked to the channel using a zinc plated steel 5/16 – 18 UNC bolt and zinc plated steel toggle bar system with a bolt torque of 10in/lb. Grates shall be made in U.S.A., and shall conform to the FHWA's "Buy America" policy 23 CFR 635.410(b) and Federal Acquisitions Regulations (FAR) 52.225 “Buy American Act”.

1.3 QUALITY ASSURANCE

A. Submittals

1. A Certificate of Compliance in conformance with the provisions of these Standard Specifications shall be furnished to the Engineer. Grates shall be independently tested to AASHTO M-306.

END OF SECTION 221319.13

SECTION 22 3000 - PLUMBING EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Commercial gas-fired water heaters.

B. Commercial electric water heaters.

C. Diaphragm-type compression tanks.

D. In-line circulator pumps.

1.2 SUBMITTALS

A. Product Data:

1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.

2. Indicate pump type, capacity, power requirements.

3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.

4. Provide electrical characteristics and connection requirements.

B. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

C. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.4 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide five year manufacturer warranty for domestic water heaters.

PART 2 PRODUCTS

2.1 WATER HEATERS

A. Manufacturers:

1. A.O. Smith Water Products Co: www.hotwater.com.
2. Vaughn Thermal Corporation: www.vaughncorp.com.
3. Bradford White: www.bradfordwhite.com.
4. Approved Equal.

B. Commercial Gas-Fired Water Heaters:

1. Type: Automatic, propane-fired, vertical storage.
2. Minimum Efficiency Required: ASHRAE Std 90.1 I-P.
3. Tank: Antimicrobial-infused, enamel-lined, welded steel, ASME labeled; multiple flue passages, 4-inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber, encased in corrosion-resistant steel jacket; baked-on enamel finish; floor shield and legs.
4. Accessories:
    a. Water Connections: Brass.
    b. Dip Tube: Brass.
    c. Drain valve.
    d. Anode: Magnesium.

C. Commercial Electric Water Heaters:

1. Type: Factory-assembled and wired, electric, vertical storage.
2. Minimum Efficiency Required: ASHRAE Std 90.1 I-P.
3. Tank: Glass lined welded steel; 4 inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber encased in corrosion-resistant steel jacket; baked-on enamel finish.
4. Controls: Automatic immersion water thermostat; externally adjustable temperature range from 60 to 180 degrees F, flanged or screw-in nichrome elements, high temperature limit thermostat.
5. Accessories:

a. Water Connections: Brass.

b. Dip Tube: Brass.

c. Drain valve.

d. Anode: Magnesium.

e. Temperature and Pressure Relief Valve: ASME labeled.

6. Heating Elements: Flange-mounted immersion elements; individual elements sheathed with Incoloy corrosion-resistant metal alloy, rated less than 75 W/sq in.

2.2 DIAPHRAGM-TYPE COMPRESSION TANKS

A. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.

B. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 12 psig.

2.3 IN-LINE CIRCULATOR PUMPS

A. Manufacturers:

1. Armstrong Fluid Technology: www.armstrongfluidtechnology.com.

2. Bell & Gossett, a brand of Xylem, Inc: www.bellgossett.com.

3. Approved Equal.

B. Casing: Bronze, rated for 125 psig working pressure, with stainless steel rotor assembly.

C. Impeller: Bronze.

D. Shaft: Alloy steel with integral thrust collar and two oil lubricated bronze sleeve bearings.

E. Seal: Carbon rotating against a stationary ceramic seat.

F. Drive: Flexible coupling.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions required for applicable certifications.

B. Coordinate with plumbing piping and related electrical work to achieve operating system.

C. Pumps:

1. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

END OF SECTION

SECTION 22 4000 - PLUMBING FIXTURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Flush valve water closets.

B. Wall hung urinals.

C. Lavatories.

D. Sinks.

E. Bi-level, electric water coolers.

F. Service sinks.

G. Emergency eye wash.

H. Emergency combination eyewash/showers.

1.2 RELATED REQUIREMENTS

A. Section 22 1005 - Plumbing Piping.

B. Section 22 1006 - Plumbing Piping Specialties.

1.3 SUBMITTALS

A. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

B. Maintenance Data: Include fixture trim exploded view and replacement parts lists.

C. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.2 FLUSH VALVE WATER CLOSETS

A. Water Closets:

1. Vitreous china, ASME A112.19.2, wall hung, siphon jet flush action, china bolt caps.

2. Flush Valve: Exposed (top spud).

3. Flush Operation: Manual, oscillating handle.

4. Handle Height: 44 inches or less.

B. Flush Valves:

1. Manual Operated:

a. Type: ASME A112.18.1 or ASME A112.19.5; diaphragm type complete with vacuum breaker stops, and accessories.

b. Supplied Volume Capacity: 1.5 gal per flush.

C. Toilet Seats:

1. Plastic: Solid, white finish, enlongated shape, open front, hinged seat cover, and brass bolts with covers.

D. Water Closet Carriers:

1. ASME A112.6.1M; adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers.

2.3 URINALS

A. ASME A112.19.2; vitreous china wall urinal with integral flushing rim, removable stainless steel strainer 3/4 inch top spud.

B. Trapway Outlet: Integral.

C. Flush Valves:

1. Exposed: ASME A112.18.1; chrome plated, diaphragm type with oscillating handle, escutcheon, integral screwdriver stop, vacuum breaker; maximum 1.0 gal flush volume.

D. Stall Urinal Carriers:

1. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs.

2.4 LAVATORIES

A. Drop-In Basin:

1. Vitreous China: ASME A112.19.2; self-rimming, white, oval shape, front overflow, soap depression, seal of putty, caulking, or concealed vinyl gasket, and white finish. Size as indicated on drawings with 4-inch centerset spacing.

B. Supply Faucet:

1. ASME A112.18.1; chrome plated combination supply fitting with pop-up waste, water economy aerator with maximum flow of 2.2 gpm, single lever handle.

2.5 SINKS

A. Double Basin Kitchen Sink (KS-A): Undermount double equal bowl kitchen sink; stainless steel; brushed satin finish; sound dampening rubber pads and insulation coating.

1. Faucet: Single handle pull down spray kitchen faucet; ceramic disk valve cartridge; metal body and handle; nylon braided pull out hose with check valves; lead free. Meets ADA ANSI A117.1 requirements.

B. Single Bowl Kitchen Sink (KS-B): Undermount single bowl kitchen sink; stainless steel; brushed satin finish; sound dampening rubber pads and insulation coating.

1. Faucet: Single handle pull down spray kitchen faucet; ceramic disk valve cartridge; metal body and handle; nylon braided pull out hose with check valves; lead free. Meets ADA ANSI A117.1 requirements.

2.6 BI-LEVEL, ELECTRIC WATER COOLERS

A. Water Cooler: Bi-level, electric, mechanically refrigerated; surface mounted, ADA compliant; stainless steel top, vinyl on steel body, elevated anti-squirt bubbler with stream guard, automatic stream regulator, push button, mounting bracket; integral air cooled condenser and stainless steel grille.

1. Capacity: 8 gph of 50 degrees F water with inlet at 80 degrees F and room temperature of 90 degrees F, when tested in accordance with ASHRAE Std 18.

2. Electrical: 115 VAC, 60 Hertz compressor, 6 foot cord and plug for connection to electric wiring system including grounding connector.

B. Bottle Filler: Materials to match fountain.

2.7 SERVICE SINKS

A. Utility Tub: One piece molded construction (polypropylene); faucet with 6" swing end with aerator and hose end; leakproof, integrally molded-in drain with drain stopper; accomodates dual handle faucet with 4" center; includes finished steel legs with adjustable levelers for floor mounting; mold and mildew resistant components.

2.8 EMERGENCY EYE WASH

A. Emergency Eye Wash: ANSI Z358.1; free standing, self-cleaning, non-clogging eye wash with quick opening, full-flow valves, ABS eye wash receptor, twin eye wash heads, PVC control valve and fittings.

2.9 COMBINATION EMERGENCY EYEWASH/SHOWERS

A. Shower: ANSI Z358.1; free standing, self- cleaning, non-clogging 3-1/10 inch diameter plastic deluge shower head with elbow, one inch full flow valve with pull chain and 8 inch diameter ring, one inch interconnecting fittings.

B. Emergency Eye Wash: ANSI Z358.1; self-cleaning, non-clogging eye and face wash with quick opening, full-flow valves, plastic eye and face wash receptor, twin eye wash heads and face spray ring, plastic dust cover, copper alloy control valve and fittings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Verify that electric power is available and of the correct characteristics.

C. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.2 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

A. Install each fixture with trap, easily removable for servicing and cleaning.

B. Provide chrome-plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.

C. Install components level and plumb.

D. Install and secure fixtures in place with wall supports and bolts.

E. Solidly attach water closets to floor with lag screws. Lead flashing is not intended to hold fixture in place.

3.4 INTERFACE WITH WORK OF OTHER SECTIONS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.5 ADJUSTING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.6 CLEANING

A. Clean plumbing fixtures and equipment.

3.7 PROTECTION

A. Protect installed products from damage due to subsequent construction operations.

B. Repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 23 0510 - BASIC MECHANICAL REQUIREMENTS

PART 1 GENERAL

1.1 WORK INCLUDED

A. Provide all labor, tools, materials, accessories, parts, transportation, taxes, and related items, essential for installation of the work and necessary to make work complete and operational. Provide new equipment and material unless otherwise called for. References to codes, specifications, and standards called for in the specification sections and on the drawings mean the latest edition, amendment, and revision of such referenced standard in effect on the date of these contract documents.

B. The Contractor is advised that there is lead based paint and lead containing building components within the existing structures.

1.2 LICENSING

A. The Contractor shall hold a license to perform the work as issued by the local jurisdiction.

B. The Contractor shall be responsible for reviewing the local jurisdiction requirements prior to bidding.

1.3 PERMITS

A. Apply for and obtain all required permits and inspections, pay all fees and charges including all service charges.

1.4 CODE COMPLIANCE

A. Provide work in compliance with the following:

1. The Building Code of New York State including The Fire Code; Property Maintenance Code; Plumbing Code, Mechanical Code and Fuel Gas Code; and The Energy Code of New York.

2. New York State Department of Labor Rules and Regulations.

3. Occupational Safety and Health Administration (OSHA).

4. National Fuel Gas Code, NFPA 54.

5. National Electrical Code, NFPA 70.

6. Local Codes and Ordinances.

7. Life Safety Codes, NFPA 101 (2003).

8. New York Board of Fire Underwriters.

9. Part 4 of Title 12 Rules and Regulations of the State of New York Industrial Code Rule No. 4 (12NYCRR4)

1.5 GLOSSARY

A. AGA American Gas Association

B. AMCA Air Moving and Conditioning Association, Inc.

C. ANSI American National Standards Institute

D. ARI Air Conditioning and Refrigeration Institute

E. ASHRAE American Society of Heating, Refrigeration, and Air Conditioning Engineers, Inc.

F. ASME American Society of Mechanical Engineers

G. ASPE American Society of Plumbing Engineers

H. ASTM American Society for Testing Materials

I. NEC National Electrical Code

J. NEMA National Electrical Manufacturer's Association

K. NFPA National Fire Protection Association

L. SMACNA Sheet Metal and Air Conditioning Contractors National Association

M. UL Underwriter's Laboratories, Inc.

N. OSHA Occupational Safety and Health Administration

O. NYS/UFPBC New York State Uniform Fire Prevention and Building Code

1.6 SHOP DRAWINGS/PRODUCT DATA/SAMPLES

A. Submit Shop Drawings on all items of equipment and materials to be furnished and installed. Submission of Shop Drawings and samples shall be accompanied by a transmittal letter, stating name of project and contractor, number of drawings, titles, and other pertinent data called for in individual sections. Shop Drawings shall be dated and contain: Name of project; name of prime professional; name of prime contractor; description or names of equipment, materials and items; and complete identification of locations at which materials or equipment are to be installed. Individual piecemeal or incomplete submittals will not be accepted. Similar items, (all types specified) shall be submitted at one time. Number each submittal by trade. Indicate deviations from contract

requirements on Letter of Transmittal. Shop Drawings will be given a general review only. Corrections or comments made on the Shop Drawings during the review do not relieve Contractor from compliance with requirements of the drawings and specifications. The Contractor is responsible for: confirming and correcting all quantities; checking electrical characteristics and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner.

B. See Specification Section 01 3000 Administrative requirements for Submittal procedures.

1.7 PROTECTION OF PERSONS AND PROPERTY

A. Contractor shall assume responsibility for construction safety at all times and provide as part of contract all trench or building shoring, scaffolding, shielding, dust/fume protection, mechanical/electrical protection, special grounding, safety railings, barriers, and other safety features required to provide safe conditions for all workmen and site visitors.

1.8 EQUIPMENT ARRANGMENTS

A. The contract documents are prepared on basis of one manufacturer as “design equipment,” even though other manufacturer’s names are listed as acceptable makes. If Contractor elects to use one of the listed makes other than “design equipment,” submit detailed drawings, indicating proposed installation of equipment. Show maintenance arrangement. Make required changes in the work of other trades, at no increase in any contract. Provide larger motors, feeders, breakers, and equipment, additional control devices, valves, fittings and other miscellaneous equipment required for proper operation, and assume responsibility for proper location of roughing and connections by other trades. Remove and replace door frames, access doors, walls, ceilings, or floors required to install other than design make equipment. If revised arrangement submittal is rejected, revise and resubmit specified “design equipment” item which conforms to contract documents.

1.9 CONTINUITY OF SERVICES

A. The building will be in use during construction operations. Maintain existing systems in operation within all rooms of building at all times. Refer to “General Conditions of the Contract for Construction” for temporary facilities for additional contract requirements. Schedules for various phases of contract work shall be coordinated with all other trades and with Owner’s Representative. Provide, as part of contract, temporary mechanical connections and relocations as required to accomplish the above. Obtain approval in writing as to date, time, and location for shutdown of existing mechanical facilities or associated services.

1.10 ROUGHING

A. Due to small scale of Drawings, it is not possible to indicate all offsets, fittings, changes in elevation, interferences, etc. Make necessary changes in contract work, equipment

locations, etc., as part of a contract to accommodate work to obstacles and interferences encountered. Before installing, verify exact location and elevations at work site. DO NOT SCALE plans. If field conditions, details, changes in equipment or shop drawing information require an important rearrangement, report same to Owner's Representative for review. Obtain written approval for all major changes before installing.

B. Install work so that items both existing and new are operable and serviceable. Eliminate interference with removal of coils, motors, filters, belt guards and/or operation of doors. Provide easy, safe, and code mandated clearances at controllers, motor starters, valve access, and other equipment requiring maintenance and operation. Where Contractor could not reasonably be expected to find such trade interferences due to concealment in walls, ceiling or floors, such relocations will be done by Change Order, if not, included in contract work. Contractor shall relocate existing work in way of new construction. VISIT SITE BEFORE BIDDING TO DETERMINE SCOPE OF WORK SINCE FEW OF SUCH ITEMS CAN BE SHOWN. Provide new materials, including new piping and insulation for relocated work.

C. Coordinate work with other trades and determine exact route or location of each duct, pipe, conduit, etc., before fabrication and installation. Coordinate with Architectural Drawings. Obtain from Owner's Representative exact location of all equipment in finished areas, such as thermostat, fixture, and switch mounting locations, and equipment mounting locations. Coordinate all work with the architectural reflected ceiling plans and/or existing Architecture. Mechanical drawings show design arrangement only for diffusers, grilles, registers, air terminals, and other items. Do not rough-in contract work without reflected ceiling location plans.

D. Before roughing for equipment furnished by Owner or in other contracts, obtain from Owner and other Contractors, approved roughing drawings giving exact location for each piece of equipment. Do not "rough in" services without final layout drawings approved for construction. Cooperate with other trades to insure proper location and size of connections to insure proper functioning of all systems and equipment. For equipment and connections provided in this contract, prepare roughing drawing as follows:

    1. Existing equipment: Measure the existing equipment and prepare for installation in new location.

    2. New equipment: Obtain equipment roughing drawings and dimensions, then prepare roughing-in-drawings. If such information is not available in time, obtain an acknowledgement in writing, then make space arrangements as required with Owner's Representative.

1.11 REMOVAL WORK

A. Where existing equipment removals are called for, submit complete list to Owner's Representative. All items that Owner wishes to retain that do not contain asbestos or PCB Material shall be delivered to location directed by Owner. Items that Owner does not wish to retain shall be removed from site and legally disposed of. Removal and disposal of material containing asbestos and/or PCB's shall be in accordance with Federal, State, and Local law requirements. Where equipment is called for to be relocated, contractor shall carefully remove, clean and recondition, then reinstall. Remove all abandoned

piping, equipment, ductwork, tubing, supports, fixtures, etc. Visit each room, crawl space, and roof to determine the total Scope of Work. The disturbance or dislocation of asbestos-containing materials causes asbestos fibers to be released into the building's atmosphere, thereby creating a health hazard to workmen and building occupants. Consistent with Industrial Code Rule 56 and the content of recognized asbestos-control work, the Contractor shall apprise all of his workers, supervisory personnel, subcontractors, Owner and Consultants who will be at the job site of the seriousness of the hazard and of proper safeguards and work procedures which must be followed, as described in New York State Department of Labor Industrial Code Rule 56.

1.12 EQUIPMENT AND MATERIAL INSTALLATION

A. Provide materials that meet the following minimum requirements:

1. Materials shall have a flame spread rating of 25 or less and smoke developed rating of 50 or less, in accordance with NFPA 255.

2. All equipment and material for which there is a listing service shall bear a UL label.

3. Gas-fired equipment and system shall meet AGA Regulations and shall have AGA label.

4. Mechanical and electrical equipment and systems with electrical components shall be UL Listed and meet UL Standards and requirements of the NEC.

1.13 CUTTING AND PATCHING

A. Contractor shall include their required cutting and patching work unless shown as part of the General Construction work on the architectural drawings. Refer to "General Conditions of the Contract for Construction," for additional requirements. Cut and drill from both sides of walls and/or floors to eliminate splaying. Patch any cut or abandoned holes left by removals of equipment, fixtures, etc. Patch adjacent existing work disturbed by installation of new work including insulation, walls and wall covering, ceiling and floor covering, other finished surfaces. Patch openings and damaged areas equal to existing surface finish. Cut openings in prefabricated construction units in accordance with manufacturer's instructions.

1.14 PAINTING

A. Include painting for patchwork with color to match adjacent surfaces. Where color cannot be adequately matched, paint entire surface. Provide one (1) coat of primer and two (2) finish coats or as called for in the Specifications. Refer to Specifications for additional information.

1.15 CONCEALMENT

A. Conceal all contract work above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impractical, notify Owner's Representative before starting that part of the work and install only after his review. In areas with no ceilings, install only after Owner's Representative reviews and comments on arrangement and appearance.

1.16 CHASES

A. New Construction:

1. Certain chases, recessed, openings, shafts, and wall pockets will be provided as part of "General Building Construction Plans and Specifications." Contractor shall provide all other openings required for their contract work.

2. Check Architectural and Structural Design and Shop Drawings to verify correct size and location for all openings, recesses and chases in general building construction work.

3. Assume responsibility for correct and final location and size of such openings.

4. Rectify improperly sized, improperly located or omitted chases or openings due to faulty or late information or failure to check final location.

5. Provide 18 gauge galvanized sleeves and inserts. Extend all sleeves 2" above finished floor. Set sleeves and inserts in place ahead of new construction, securely fastened during concrete pouring. Correct, by drilling, omitted or improperly located sleeves. Assume responsibility for all work and equipment damaged during course of drilling. Firestop all unused sleeves.

6. Provide angle iron frame where openings are required for contract work.

B. In Existing Buildings:

1. Drill holes for floor and/or roof slab openings.

2. Multiple pipes smaller than 1" properly spaced and supported may pass through one 6" or smaller diameter opening.

3. Seal voids in fire rated assemblies with a fire-stopping seal system to maintain the fire resistance of the assembly. Provide 18 gauge galvanized sleeves at fire rated assemblies. Extend sleeves 2" above floors.

4. In wall openings, drill or cut holes to suit. Provide 18 gauge galvanized sleeves at shafts and fire rated assemblies. Provide fire-stopping seal between sleeves and wall in drywall construction. Provide fire-stopping similar to that for floor openings.

1.17 FLASHING, SEALING, FIRE-STOPPING

A. See Specification Section 23 0515 - Mechanical Firestopping.

1.18 SUPPORTS

A. Provide required supports, beams, angles, hangers, rods, bases, braces, and other items to properly support contract work. Supports shall meet the approval of the Owner's Representative. Modify studs, add studs, add framing, or otherwise reinforce studs in metal stud walls and partitions as required to suit contract work. If necessary, in stud walls, provide special supports from floor to structure above. For Precast Panels/Planks and Metal Decks, support mechanical/electrical work as determined by manufacturer and Owner's Representative. Provide heavy gauge steel mounting plates for mounting contract work. Mounting plates shall span two or more studs. Size, gauge, and strength of mounting plates shall be sufficient for equipment size, weight, and desired rigidity.

1.19 ACCESS PANELS

A. Access panels shall be furnished and installed by the Contractor. Location and size shall be the responsibility of Contractor. Bear cost of construction changes necessary due to improper information or failure to provide proper information in ample time. Access panels over 324 square inches shall have two cam locks. Contractor shall provide proper frame and door type for various wall or ceiling finishes. Access panels shall be equal to "Milcor" as manufactured by Inland Steel Products Co., Milwaukee, Wisconsin.

1.20 CONCRETE BASES

A. Provide concrete bases for all floor-mounted equipment (unless otherwise noted). Provide 3,000 lb. concrete, chamfer edges, trowel finish, and securely bond to floor by roughening slab and coating with cement grout. Bases 4" high (unless otherwise indicated); shape and size to accommodate equipment. Set anchor bolts in sleeves before pouring and after anchoring and leveling, fill equipment bases with grout.

1.21 HVAC EQUIPMENT CONNECTIONS

A. Contractor is responsible for draining, filling, venting, chemically treating and restarting any systems which are affected by work shown on the Contract Documents unless specifically noted otherwise.

B. Provide final hydronic, steam, drain, vent, and gas connections to all equipment as required by the equipment. Provide final connections, including domestic water piping, controls, and devices from equipment to outlets left by other trades. Provide equipment waste, drip, overflow and rail connections extended to floor drains.

C. Provide for Owner furnished and contractor furnished equipment all valves, piping, piping accessories, traps, pressure reducing valves, gauges, relief valves, vents, drains, insulation, sheet metal work, controls, dampers, as required.

D. Refer to manufacturer drawings and specifications for requirements of kitchen equipment, laboratory equipment and special equipment. Verify connection requirements before bidding.

1.22 DELIVERY

A. Accept materials delivered on site in manufacturer's packaging, labeled with manufacturer's identification and product information.

1.23 STORAGE AND PROTECTION OF MATERIALS

A. Store materials on dry base, at least 6" above-ground or floor. Store so as not to interfere with other work or obstruct access to buildings or facilities. Provide waterproof/windproof covering. Remove and provide special storage for items subject to moisture damage. Protect against theft or damage from any cause. Replace items stolen or damaged, at no cost to Owner.

B. Maintain ambient conditions for each product as required by each manufacturer from time of delivery. Maintain appropriate ambient conditions for installation as recommended by each manufacturer for a minimum of 24 hours prior and 24 hours after installation.

C. Refer to "General Conditions of the Contract for Construction."

1.24 FREEZING AND WATER DAMAGE

A. Take all necessary precautions with equipment, systems and building to prevent damage due to freezing and/or water damage. Repair or replace, at no charge in contract, any such damage to equipment, systems, and building. Perform first seasons winterizing in presence of Owner's operating staff.

1.25 OWNER INSTRUCTIONS

A. Before final acceptance of the work, furnish necessary skilled labor to operate all systems by seasons. Instruct designated person on proper operation, and care of systems/equipment. Repeat instructions, if necessary. Obtain written acknowledgement from person instructed prior to final payment. Contractor is fully responsible for system until final acceptance, even though operated by Owner's personnel, unless otherwise agreed in writing. List under clear plastic, operating, maintenance, and starting precautions procedures to be followed by Owner for operating systems and equipment.

1.26 MAINTENANCE MANUALS

A. Prepare Instructions and Maintenance Portfolios. Include one copy of each of approved Shop Drawings, wiring diagrams, piping diagrams spare parts lists, as-built drawings and manufacturer's instructions. Include typewritten instructions, describing equipment, starting/operating procedures, emergency operating instructions, summer-winter changeover, freeze protection, precautions and recommended maintenance procedures. Include name, address, and telephone number of supplier manufacturer representative and service agency for all major equipment items in a three ring binder with name of project on the cover. Include warranty information for all associated equipment. Deliver to Owner's Representative before request for final acceptance.

1.27 RECORD DRAWINGS

A. The Contractor shall obtain at his expense one (1) set of construction Contract Drawings including non-reproducible black and white prints and one set of reproducible drawings for the purpose of recording record conditions.

B. The Contractor shall perform all survey work required for the location and construction of the work and to record information necessary for completion of the record drawings. Record drawings shall show the actual location of the constructed facilities in the same manner as was shown on the bid drawings. All elevations and dimensions shown on the drawings shall be verified or corrected so as to provide a complete and accurate record of the facilities as constructed.

C. It shall be the responsibility of the Contractor to mark each sheet of the non-reproducible drawings in pencil and to record thereon in a legible manner, any and all approved field changes and conditions as they occur. A complete file of approved field sketches, diagrams, and other changes shall also be maintained. At completion of the work, each sheet of record prints, plus all approved field sketches and diagrams shall be used in preparation of the reproducible record drawings.

D. Completed reproducible drawings shall be certified as reflecting record conditions and submitted to the engineer for approval.

1.28 ADDITIONAL ENGINEERING SERVICES

A. In the event that the Consultant is required to provide additional engineering services as a result of substitution of equivalent materials or equipment by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Consultant is required to examine and evaluate any changes proposed by the Contractor for the convenience of the Contractor, then the Consultant's expenses in connection with such additional services shall be paid by the Contractor and may be deducted from any monies owed to the Contractor.

1.29 FINAL INSPECTION

A. Upon completion of all punch list items, the Contractor shall provide a copy of the punch list back to the Architect/Engineer with each items noted as completed or the current status of the item. Upon receipt, the Architect/Engineer will schedule a final inspection.

1.30 ALL TRADES TEMPORARY HEAT

A. Refer to the Standard General Conditions of the contract for Construction and Supplemental General Conditions.

1.31 HVAC MAINTENANCE OF SYSTEMS DURING TEMPORARY USE PERIODS

A. Provide each air handling system with a set of prefilters in addition to the permanent filters. Furnish four sets of prefilters for each system for use when system is operated for temporary heating or cooling. During such use, change prefilters as often as directed by Owner's Representative. Provide necessary temporary throw away filters in all return openings to keep dust out of ductwork. Change as often as necessary. Remove all such temporary filters upon completion. Use supply units only. Do not operate return fans.

B. Blank-off outside air intake opening during temporary heating period. Install first set of permanent filters and prefilters.

C. Adjust dampers on supply system.

D. Set all heating coil control valves for manual operation.

E. Do not install any grilles or diffusers at room terminal ends of ducts until permission is given.

F. Assume responsibility for systems and equipment at all times, even though used for temporary heat or ventilating. Repair or replace all dented, scratched or damaged parts of systems prior to final acceptance.

G. Remove concrete, rust, paint spots, other blemishes, then clean.

H. Just prior to final acceptance, remove used final filter. Deliver all unused sets of prefilters to the Owner and obtain written receipt. Properly lubricate system bearings before and during temporary use. Maintain thermostats, freeze stats, overload devices, and all other safety controls in operating condition.

1.32 CLEANING

A. It is the Contractor's responsibility to keep clean all equipment and fixtures provided under this contract for the duration of the project. Each trade shall keep the premises free from an accumulation of waste material or rubbish caused by his operations. The facilities require an environment of extreme cleanliness, and it is the Contractor's

responsibility to adhere to the strict regulations regarding procedures on the existing premises. After all tests are made and installations completed satisfactorily:

B. Thoroughly clean entire installation, both exposed surfaces and interiors.

C. Remove all debris caused by work.

D. Remove tools, surplus, materials, when work is finally accepted.

1.33 SYSTEM START-UP AND TESTING

A. All new heating and ventilating shall be started up and operated at normal operating temperature for a period of 24 hours to "bake-off" the equipment. The associated ventilation system shall run on 100% outside air during the bake-off for an additional eight hours to purge the building. This work shall be completed prior to building occupancy or if the work is not completed in time for summer "bake-off" on a Saturday with the Contractor responsible for being on site during the entire purge and bake-off operation.

B. Work of any contract which includes system "bake-off", system start-up, system cut-over or staff training shall not be done one week prior to and one week after the opening of the building/addition except upon written approval by the Owner.

C. Start-up and testing of HVAC systems shall occur while the building is not occupied by Owner and only after notice to the Project Inspector is made at least 24 hours in advance. The Contractor shall be responsible for providing temporary filter media over all supply air registers and diffusers during the HVAC system start-up procedure. The Contractor shall provide airtight plastic covers over all supply and return air openings prior to the start of construction by any Contractor. The plastic shall be maintained airtight throughout the project construction and removed only with the approval of the Project Inspector.

END OF SECTION

SECTION 23 0515 - MECHANICAL FIRESTOPPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Firestopping materials.

B. Firestopping of all penetrations, openings, and interruptions to fire rated assemblies, whether indicated on drawings or not, including but not limited to piping, tubing, ductwork and similar utilities passing through or penetrating fire rated walls and floor assemblies.

1.2 RELATED SECTIONS

A. Refer to "Code Compliance Drawings" for location of fire rated assemblies. At a minimum all corridor walls and all floors between stories have a 1hour rating.

1.3 REFERENCES

A. ASTM International:

1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

B. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.

C. Underwriters Laboratories Inc.:

1. UL 263 - Fire Tests of Building Construction and Materials.

2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

3. UL 1479 - Fire Tests of Through-Penetration Firestops.

4. UL - Fire Resistance Directory.

D. Mechanical Code of New York State.

1.4 FIRE-STOP SYSTEM PERFORMANCE REQUIREMENTS

A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration fire-stop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

1. Fire-resistance-rated walls including fire walls, fire partitions, fire barriers and smoke barriers.

2. Fire-resistance-rated horizontal assemblies including floors and ceiling membranes of roof/ceiling assemblies.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

1.6 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs which provide the specified fire ratings when tested in accordance with methods indicated.

1. Listing in the current-year classification or certification books of UL will be considered as constituting an acceptable test report.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for 3 days after installation of materials.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Hilti.

B. Nelson Fire Stop Products.

C. Specified Technology.

D. 3M Fire Protection Products.

E. Approved equals meeting UL requirements.

2.2 MATERIALS

A. Sealant Firestopping:

1. Intumescent firestop sealant designed to expand when exposed to fire.
2. Paintable
3. Fire Resistance: Up to 4 hours
4. Curing Time: 14-21 days
5. Elongation: 5%
6. Density: 1.5 g/cm3
7. Product: FS-ONE Intumescent Firestop Sealant manufactured by Hilti USA.
8. Uses: Insulated and uninsulated metal pipes, with or without sleeve, jacketed cables, cable bundles, plastic pipes, sheet metal duct, and top of wall joints.

B. Silicone Sealant Firestopping:

1. Silicone based firestop sealant that provides maximum movement in fire-rated joint applications and pipe penetrations.
2. Not paintable
3. Fire Resistance: Up to 4 hours
4. Elongation: 25%
5. Product: CP 601S Elastomeric Firestop Sealant manufactured by Hilti USA.
6. Uses: Joints in walls, floor to floor or fire compartments.

C. Safing Insulation:

1. Mineral-wool type insulation.
2. Thickness: 1" to 1-1/2"
3. Density: 4 to 8 pcf
4. Product: THERMAFIBER Safing Insulation

D. Sleeves:

1. Provide sleeves as required by section 1206.4 of the Mechanical Code.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration fire-stop systems to comply with fire-stop system manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration fire-stop systems.

2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration fire-stop systems. Remove loose particles remaining from cleaning operation.

3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration fire-stop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General

1. Install materials in manner described in UL Detail and in accordance with manufacturer's instructions, completely closing openings.

B. Installation

1. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.

2. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

3. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.

4. Fire Rated Surface:

a. Seal opening at floor, wall, partition, and roof as follows:

1) Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.

2) Size sleeve allowing minimum of 1 inch void between sleeve and building element.

3) Pack void with backing material.

4) Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

b. Where piping, ductwork, cables, etc. penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.

5. Non-Rated Surfaces:

a. Seal opening through non-fire rated wall, floor, ceiling, and roof opening as follows:

1) Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.

2) Size sleeve allowing minimum of 1 inch void between sleeve and building element.

3) Install type of firestopping material recommended by manufacturer.

b. Install floor plates or ceiling plate where piping penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.

c. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of pipe and tighten in place, in accordance with manufacturer's instructions.

d. Interior partitions: Seal pipe penetrations at mechanical rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

C. Identification:

1. Identify through-penetration fire-stop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of edge of the fire-stop systems so that labels will be visible to anyone seeking to remove penetrating items or fire-stop systems. Use mechanical fasteners for metal labels. For plastic labels, use self-adhering type with adhesives capable of permanently bonding labels to surfaces on which labels are placed and, in combination with label material, will result in partial destruction of label if removal is attempted. Include the following information on labels:

a. The words "Warning - Through-Penetration Fire-Stop System - Do Not Disturb. Notify Building Management of Any Damage."

b. Date of installation.

c. Through-penetration fire-stop system manufacturer's name.

3.4 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration fire-stop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration fire-stop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration fire-stop systems immediately and install new materials to produce systems complying with specified requirements.

END OF SECTION

SECTION 23 0553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Adhesive-backed duct markers.

C. Pipe markers.

1.2 REFERENCE STANDARDS

A. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2013.

1.3 SUBMITTALS

A. Product Data: Provide manufacturers catalog literature for each product required.

PART 2 PRODUCTS

2.1 IDENTIFICATION APPLICATIONS

A. Furnaces: Nameplates.

B. Ductless Split Units/Condensing Units: Nameplates.

C. Boilers: Nameplaes

D. Fans: Nameplates.

E. Control Panels: Nameplates.

F. Ductwork: Nameplates or Duct Markers.

G. Unit Heaters: Nameplates.

H. Piping: Pipe markers.

I. Pumps: Nameplates.

J. Tanks: Nameplates.

K. Thermostats: Nameplates.

2.2 NAMEPLATES

A. Manufacturers:

1. Advanced Graphic Engraving: www.advancedgraphicengraving.com.
2. Kolbi Pipe Marker Co.: www.kolbipipemarkers.com.
3. Seton Identification Products: www.seton.com.
4. Approved Equal.

B. Letter Color: White.

C. Letter Height: 1/4 inch.

D. Background Color: Black.

E. Plastic: Comply with ASTM D709.

2.3 ADHESIVE-BACKED DUCT MARKERS

A. Manufacturers:

1. Brimar Industries, Inc: www.pipemarker.com.
2. Craftmark Pipe Markers: www.craftmarkid.com.
3. Kolbi Pipe Marker Co: www.kolbipipemarkers.com.
4. Approved Equal.

B. Material: High gloss acrylic adhesive-backed vinyl film 0.0032 inch; printed with UV and chemical resistant inks.

C. Style: Individual Label.

D. Color: Yellow/Black.

2.4 PIPE MARKERS

A. Manufacturers:

1. Brady Corporation: www.bradycorp.com.
2. Kolbi Pipe Marker Co: www.kolbipipemarkers.com.
3. Seton Identification Products, a Tricor Company: www.seton.com.
4. Approved Equal.

B. Color: Comply with ASME A13.1.

C. Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

D. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

E. Color code as follows:

1. Heating, Cooling, and Boiler Feedwater: Green with white letters.

2. Toxic and Corrosive Fluids: Orange with black letters.

3. Compressed Air: Blue with white letters.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install plastic pipe markers in accordance with manufacturer's instructions.

C. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

D. Install ductwork with plastic nameplates or duct markers. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

SECTION 23 0593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Testing, adjustment, and balancing of air systems.

B. Testing, adjustment, and balancing of hydronic and refrigerating systems.

C. Measurement of final operating condition of HVAC systems.

1.2 REFERENCE STANDARDS

A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.

B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008.

C. NEBB (TAB) - Procedural Standards for Testing Adjusting and Balancing of Environmental Systems; 2015, Eighth Edition.

D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2002.

1.3 SUBMITTALS

A. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.

1. Include at least the following in the plan:

a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.

b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.

c. Discussion of what notations and markings will be made on the duct and piping drawings during the process.

d. Final test report forms to be used.

e. Procedures for formal deficiency reports, including scope, frequency and distribution.

B. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

1. Revise TAB plan to reflect actual procedures and submit as part of final report.

2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Engineer and for inclusion in operating and maintenance manuals.

3. Include actual instrument list, with manufacturer name, serial number, and date of calibration.

4. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.

5. Units of Measure: Report data in I-P (inch-pound) units only.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:

1. AABC (NSTSB), AABC National Standards for Total System Balance.

2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.

3. SMACNA (TAB).

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. TAB Agency Qualifications:

1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.

D. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.2 EXAMINATION

A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:

1. Systems are started and operating in a safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Air coil fins are cleaned and combed.
8. Access doors are closed and duct end caps are in place.
9. Air outlets are installed and connected.
10. Duct system leakage is minimized.
11. Hydronic systems are flushed, filled, and vented.
12. Pumps are rotating correctly.
13. Proper strainer baskets are clean and in place.
14. Service and balance valves are open.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

A. Hold a pre-balancing meeting at least one week prior to starting TAB work.

B. Provide additional balancing devices as required.

3.4 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.5 RECORDING AND ADJUSTING

A. Ensure recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.6 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

G. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

H. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

I. Where modulating dampers are provided, take measurements and balance at extreme conditions.

J. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries.

3.7 WATER SYSTEM PROCEDURE

A. Adjust water systems to provide required or design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

F. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

3.8 MINIMUM DATA TO BE REPORTED

A. Electric Motors:

1. Manufacturer.
2. Model/Frame.
3. HP/BHP.
4. Phase, voltage, amperage; nameplate, actual, no load.
5. RPM.
6. Starter size, rating, heater elements.
7. Sheave Make/Size/Bore.

B. V-Belt Drives:

1. Identification/location.
2. Required driven RPM.
3. Driven sheave, diameter and RPM.
4. Belt, size and quantity.

5. Motor sheave diameter and RPM.
6. Center to center distance, maximum, minimum, and actual.

C. Pumps:

1. Identification/number.
2. Manufacturer.
3. Size/model.
4. Impeller.
5. Service.
6. Design flow rate, pressure drop, BHP.
7. Actual flow rate, pressure drop, BHP.
8. Discharge pressure.
9. Suction pressure.
10. Total operating head pressure.
11. Shut off, discharge and suction pressures.
12. Shut off, total head pressure.

D. Combustion Equipment:

1. Boiler manufacturer.
2. Model number.
3. Serial number.
4. Firing rate.
5. Overfire draft.
6. Gas meter timing dial size.
7. Gas meter time per revolution.
8. Gas pressure at meter outlet.
9. Gas flow rate.
10. Heat input.
11. Burner manifold gas pressure.

12. Percent carbon monoxide (CO).
13. Percent carbon dioxide (CO2).
14. Percent oxygen (O2).
15. Percent excess air.
16. Flue gas temperature at outlet.
17. Ambient temperature.
18. Net stack temperature.
19. Percent stack loss.
20. Percent combustion efficiency.
21. Heat output.

E. Air Cooled Condensers:

1. Identification/number.
2. Location.
3. Manufacturer.
4. Model number.
5. Serial number.
6. Number of compressors.

F. Air Moving Equipment:

1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Arrangement/Class/Discharge.
6. Air flow, specified and actual.
7. Return air flow, specified and actual.
8. Outside air flow, specified and actual.
9. Total static pressure (total external), specified and actual.

10. Inlet pressure.
11. Discharge pressure.
12. Sheave Make/Size/Bore.
13. Number of Belts/Make/Size.
14. Fan RPM.

G. Return Air/Outside Air:

1. Identification/location.
2. Design air flow.
3. Actual air flow.
4. Design return air flow.
5. Actual return air flow.
6. Design outside air flow.
7. Actual outside air flow.
8. Return air temperature.
9. Outside air temperature.
10. Required mixed air temperature.
11. Actual mixed air temperature.
12. Design outside/return air ratio.
13. Actual outside/return air ratio.

H. Fans:

1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Air flow, specified and actual.
6. Total static pressure (total external), specified and actual.
7. Inlet pressure.

8. Discharge pressure.
9. Sheave Make/Size/Bore.
10. Number of Belts/Make/Size.
11. Fan RPM.

END OF SECTION

SECTION 23 0713 - DUCT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Duct insulation.

B. Duct Liner.

C. Insulation jackets.

1.2 RELATED REQUIREMENTS

A. Section 23 0515- Mechanical Firestopping.

B. Section 23 0553 - Mechanical Identification.

C. Section 23 3100 - Ductwork.

1.3 REFERENCE STANDARDS

A. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2007.

B. ASTM C 518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2004.

C. ASTM C 553 - Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2008.

D. ASTM C 612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2009.

E. ASTM C 1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2005.

F. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2010.

G. ASTM E 96/E 96M - Standard Test Methods for Water Vapor Transmission of Materials; 2005.

H. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association; 2005.

1.4 SUBMITTALS

A. Product Data: Manufacturer's catalog cuts sheets, specifications, and installation instructions for the following:

1. Insulation Materials.

2. Jacket Materials.

B. Materials Schedule: Itemize insulation materials and thicknesses for each specified application in Insulation Material Schedules in Part 3 of this Section. Where optional materials are specified, indicate the option selected.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the type of work specified in this section, with minimum five years of experience.

B. Regulatory Requirements:

1. Insulation installed inside buildings, including duct lining materials, laminated jackets, mastics, sealants, and adhesives shall have a Fire Spread/Smoke Developed Rating of 25/50 or less based on ASTM E 84.

1.6 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of insulations, adhesives, mastics, and insulation cements.

B. Maintain temperature before, during, and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.1 FIBROUS GLASS INSULATION

A. Composed principally of fibers manufactured from rock, slag, or glass, with or without binders, and asbestos free.

B. Manufacturers:

1. Knauf Insulation.

2. Johns Manville Corporation.

3. Owens Corning Corporation.

C. Type 'A' Insulation: ASTM C 553; Flexible Blanket.

1. 'K' value: 0.31 at 75 degrees F, when tested in accordance with ASTM C 518.
2. Maximum Service Temperature: 450 degrees F.
3. Minimum Density: 1.0 pcf.

D. Type 'B' Insulation: ASTM C 612; Rigid Board.

1. 'K' value: 0.26 at 75 degrees F, when tested in accordance with ASTM C 518.
2. Maximum Service Temperature: 450 degrees F.
3. Minimum Density: 3.0 pcf or 6.0 pcf as specified.

E. Type 'C' Insulation: ASTM C 1071; Thermal and Acoustic Duct Liner Board Insulation.

1. 'K' value: 0.27 at 75 degrees F, when tested in accordance with ASTM C 518.
2. Maximum Service Temperature: 250 degrees F.
3. Minimum Density: 3.0 pcf.
4. Erosion, temperature, and fire resistant type; NFPA 90-A and 90-B.
5. Minimum Noise Reduction Coefficients:
    a. 1/2 inch Thickness: 0.30.
    b. 1 inch Thickness: 0.45.
    c. 1-1/2 inch Thickness: 0.60.

2.2 INSERTS

A. High Density Jacketed Insulation Inserts for Hangers and Supports:

1. For Use with Fibrous Glass Insulation: ASTM C 612 Fibrous Glass Board.
    a. 'K' value: 0.26 at 75 degrees F, when tested in accordance with ASTM C 518.
    b. Minimum Density: 6.0 pcf.

2.3 JACKETS

A. Laminated Vapor Barrier Jackets: Factory applied by insulation manufacturer, conforming to ASTM C 1136.

1. Type I: Reinforced white kraft and aluminum foil laminate with kraft facing out.

2. Type II: Reinforced aluminum foil and kraft laminate with foil facing out.

3. Laminated vapor barrier jackets are not required for flexible elastomeric foam insulation.

B. Canvas Jackets: Fire retardant cotton duck, 6 oz/sq yd, complying with NFPA 701.

C. Aluminum Jacket: ASTM B 209 formed aluminum sheet, Type 1100, 3003, 3105, or 5005, Temper H14.

1. Thickness: 0.020 inch sheet.

2. Finish: Smooth.

3. Joining: Longitudinal slip joints and 2 inch laps.

4. Fastening Devices:

a. Metal Jacket Bands: 1/2 inch wide; 0.020 inch thick Type 18-8 stainless steel.

b. Wing Seals: Type 18-8 stainless steel, 0.032 inch thick.

c. Sheet Metal Screws: Pan-head Type A hardened aluminum, or stainless steel.

2.4 ADHESIVES, MASTICS, AND SEALERS

A. Lagging Adhesive (Canvas Jackets): Childers' CP-50A, Epolux's Cadalag 336, Foster's 30-36.

B. Vapor Seal Adhesive (Fibrous Glass Insulation): Childers' CP-82, Epolux's Cadoprene 400, Foster's 85-75 or 85-20.

C. Vapor Barrier Mastic/Joint Sealer (Fibrous Glass Insulation): Childers' CP-30, Epolux's Cadalar 670, Foster's 95-44 or 30-35.

D. Adhesive (Flexible Elastomeric Foam): Armstrong's 520, Childers' CP-80, Epolux's Cadoprene 488, Foster's 82-40.

2.5 MISCELLANEOUS MATERIALS

A. Insulation Fasteners:

1. Manufacturers:

a. Duro-Dyne Corporation.

b. Erico Fastening Systems Inc.

c. Carlisle Hardcast Inc.

2. Fastener Type: Galvanized steel, impact applied or welded with integral head, complete with self-locking insulation retaining washers.

B. Pressure Sensitive Tape for Sealing Laminated Jackets:

1. Manufacturers:

a. Alpha Associates.

b. Childers.

c. Morgan Adhesive.

2. Tape Type: Same construction as jacket.

C. Metal Corner Angles: Galvanized steel, 2 inch x 2 inch x 28 gage.

D. Reinforcing Membrane:

1. Manufacturers:

a. Alpha Associates Style 59.

b. Childers' Chil-Glas.

c. Foster's Mast-A-Fab.

PART 3 EXECUTION

3.1 PREPARATION

A. Perform the following prior to starting insulation Work:

1. Install hangers, supports, and appurtenances in their permanent locations.

2. Complete testing of ductwork and equipment.

3. Clean and dry surfaces to be insulated.

3.2 INSTALLATION

A. General:

1. Install the Work of this Section in accordance with manufacturer's printed installation instructions unless otherwise specified.

2. All ductwork shall be thermally insulated in accordance withe the New York State Energy Conservation Code and NAIMA National Insulation Standards.

3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.

4. Insulate ducts prior to erection in place when ducts are required to be installed proximate to walls, ceilings, equipment or other ductwork which will not permit adequate space for installation of insulation after ducts are installed.

B. Fibrous Glass Board Insulation Application:

1. Secure insulation to ductwork with insulation fasteners spaced 3 inches in from all corners of ducts, with intermediate fasteners at maximum 16 inch centers in all directions.

2. Butt edges of insulation and fill voids with similar insulation.

3. Seal longitudinal jacket laps continuously with vapor seal adhesive minimum 1-1/2 inch wide.

4. Lap circumferential joints with 4 inch wide jacket material and seal laps continuously with vapor barrier adhesive or 3 inch wide pressure sensitive sealing tape.

5. Install metal corner angles over the jacketed insulated corners. Seal exposed ends of insulation with vapor barrier mastic.

6. Vapor seal breaks in vapor barrier jacketing, exposed surfaces of duct insulation fasteners, and metal corner angles with pressure sensitive sealing tape or coat with vapor barrier mastic.

7. Field apply 6 oz canvas jacket over the vapor barrier jacketed insulation where indicated on Schedule of Ductwork Insulation in this Section.

    a. Apply canvas jacket with lagging adhesive with a 2 inch lap on all seams.

    b. Use outward clinching staples for additional securement of canvas to bottom of ducts in excess of 48 inch width.

    c. Apply heavy coat of lagging adhesive to entire canvas surface.

8. Place trapeze hangers outside of jacketed insulated ducts.

    a. Install high density insulation inserts, of thickness equal to insulation minimum of 4 inch width by the bottom dimension of the duct at points of support.

    b. Continuously jacket insulated ducts and filler pieces through supports.

C. Fibrous Glass Blanket Insulation Application:

1. Cut insulation to stretch-out dimensions as recommended by insulation manufacturer.

2. Remove 2 inch wide strip of insulation material from the jacketing on the longitudinal and circumferential joint edges to form and overlapping flap. Install insulation with jacketing outside so flap overlaps insulation and jacketing on other end.

3. Butt ends of insulation tightly together. Do not compress insulation at duct corners on rectangular or square ductwork.

4. Staple joints with outward clinching staples minimum 6 inches on center and seal with pressure sensitive sealing tape.

5. Cut off protruding ends of fasteners flush with insulation surface and seal with pressure sensitive sealing tape.

6. Seal any tears, punctures, and penetrations of insulation jacketing with sealing tape.

7. Insulation fasteners:

    a. Install duct insulation fasteners on bottom side of horizontal duct runs when bottom dimension of the duct is in excess of 24 inches.

    b. Install duct insulation fasteners on sides of duct risers having a dimension in excess of 24 inches.

    c. Evenly space fasteners where required maximum of 16 inches on center in all directions.

D. Duct Liner Application:

1. Adhere insulation with adhesive for 90 percent coverage only where mechanical fasteners can not be used due to space or size constraints.

2. Secure insulation with mechanical liner fasteners. Refer to SMACNA HVAC Duct Construction Standards - Metal and Flexible for spacing.

3. Seal and smooth joints. Seal and coat transverse joints.

4. Seal liner surface penetrations with adhesive.

5. Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.

3.3 SCHEDULE OF DUCTWORK INSULATION

A. Exhaust Ducts Within 10 ft of Exterior Openings:

1. Type 'C' Thermal and Acoustic Duct Liner Board Insulation

    a. Thickness: 1 inch.

B. 100% Outside Air Ducts:

1. Concealed inside building envelope in unconditioned spaces:

a. Type 'A' Flexible Blanket.

1) Minimum Thickness: 2 inch.

2) Minimum R value: R-5.

3) Jacket Type: Type I or Type II.

b. Type 'B' Rigid Board.

1) Minimum Thickness: 1-1/2 inch.

2) Minimum R value: R-5.

3) Jacket Type: Type I or Type II.

2. Exposed inside building envelope:

a. Type 'B' Rigid Board.

1) Minimum Thickness: 1-1/2 inch.

2) Minimum R value: R-5.

3) Jacket Type:

(a) Type I with Canvas Outer Jacket in unclassified and non-corrosive dry areas (Boiler Room, Electrical Room, Storage Room, etc.).

(b) Aluminum jacket in all process mechanical areas that are corrosive areas, wet areas, or hazardous areas. (Bar Screen Room, Thickening Room, etc.)

C. Air Conditioning Supply and Return; Heating Supply and Return:

1. Concealed inside building envelope in unconditioned spaces:

a. Type 'A' Flexible Blanket.

1) Minimum Thickness: 2 inch.

2) Minimum R value: R-5.

3) Jacket Type: Type I or Type II.

b. Type 'B' Rigid Board.

1) Minimum Thickness: 1-1/2 inch.

2) Minimum R value: R-5.

3) Jacket Type: Type I or Type II.

2. Exposed inside building envelope in unconditioned spaces & mechanical rooms:

a. Type 'B' Rigid Board.

1) Minimum Thickness: 1-1/2 inch.

2) Minimum R value: R-5.

3) Jacket Type: Type I with Canvas Outer Jacket.

END OF SECTION

SECTION 23 0719 - PIPING AND EQUIPMENT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.2 RELATED REQUIREMENTS

A. Section 23 0515 - Mechanical Firestopping.

B. Section 23 0553 - Mechanical Identification.

C. Section 23 2113 - Hydronic Piping.

D. Section 23 2300 - Refrigerant Piping.

1.3 REFERENCE STANDARDS

A. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2007.

B. ASTM C 518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2004.

C. ASTM C 533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2009.

D. ASTM C 547 - Standard Specification for Mineral Fiber Pipe Insulation; 2007.

E. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2010.

F. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.

G. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Product Data: Manufacturer's catalog cut sheets, specifications, and installation instructions for the following:

1. Insulation Materials.

2. Jacket Materials.

B. Materials Schedule: Itemize insulation materials and thicknesses for each specified application in Insulation Material Schedules in Part 3 of this Section. Where optional materials are specified, indicate the option selected.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Company specializing in performing the type of Work specified in this Section, with minimum five years of documented experience.

B. Regulatory Requirements:

1. Insulation installed inside buildings, including laminated jackets, mastics, sealants and adhesives shall have a Fire Spread/Smoke Developed Rating of 25/50 or less based on ASTM E 84, NFPA 255, and UL 723.

1.6 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of insulations, adhesives, mastics, and insulation cements.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.1 PIPING INSULATION

A. Fibrous Glass (Mineral Fiber) Insulation: Composed principally of fibers manufactured from rock, slag, or glass, with or without binders, and asbestos free.

1. Manufacturers:

a. Johns Manville Corporation.

b. Knauf Fiber Glass.

c. Owens Corning Corporation.

2. Preformed Pipe Insulation: Minimum density 3 pcf; ASTM C 547:

a. Class 1 (Suitable for Temperatures Up to 450 degrees F): 'K' value of 0.26 at 75 degrees F.

b. Class 2 (Suitable for Temperatures 451 to 650 degrees F): 'K' value of 0.46 at 300 degrees F.

c. Class 3 (Suitable for Temperatures 651 to 1200 degrees F): 'K' value of 0.56 at 300 degrees F.

3. Premolded Fitting Insulation: Minimum density 4.0 pcf, K of 0.26 at 75 degrees F; ASTM C 547, Class 1.

4. Insulation Inserts for PVC Fitting Jackets: Minimum density 1.5 pcf, K of 0.28 at 75 degrees F; ASTM C 553, Type III.

a. Suitable for temperatures up to 450 degrees F.

B. Flexible Elastomeric Foam Insulation:

1. Manufacturers:

a. Armacell Engineered Foams.

b. Rubatex Corporation.

c. Enviro-tec Corporation.

2. Preformed Pipe and Fitting Insulation: ASTM C 534, Type I.

3. FM tested and approved, meeting the following:

a. Maximum Water Vapor Transmission: 0.10 perm-inch based on ASTM E 96, Procedure A.

b. K of 0.27 at 75 degrees F based on ASTM C 518 or C 177.

c. Fire Spread/Smoke Developed Rating: 25/50 or less based on ASTM E 84.

4. Polyethylene and polyolefin insulation is not acceptable.

C. High Density Jacketed Insulation Inserts for Hangers and Supports:

1. Manufacturers:

a. Johns Manville Corporation.

b. Knauf Fiber Glass.

c. Owens Corning Corp.

2. For Use with Fibrous Insulation:

a. Cold Service Piping:

1) Polyurethane Foam: Minimum density 4 pcf, K of 0.13 at 75 degrees F, minimum compressive strength of 125 psi.

b. Hot Service Piping:

1) Calcium Silicate: Minimum density of 15 pcf, K of 0.50 at 300 degrees F; ASTM C 610.

2) Perlite: Minimum density 12 pcf, K of 0.60 at 300 degrees F; ASTM C 610.

3. For Use with Flexible Elastomeric Foam Insulation: Hardwood dowels and blocks, length or thickness equal to insulation thickness, other dimensions as required.

D. Cements:

1. Fibrous Glass Thermal Insulating Cement: Asbestos free; ASTM C 195.

2. Fibrous Glass Hydraulic Setting Thermal Insulating and Finishing Cement: ASTM C 449/C 449M.

2.2 INSULATION JACKETS AND FITTING COVERS

A. Laminated Vapor Barrier Jackets for Piping Insulation: Factory applied by insulation manufacturer, conforming to ASTM C 1136, Type I.

1. Type I: Reinforced white kraft and aluminum foil laminate with kraft facing out.

a. Pipe Jackets: Furnished with integral 1-1/2 inch self sealing longitudinal lap, and separate 3 inch wide adhesive backed butt strips.

2. Type II: Reinforced aluminum foil and kraft laminate with foil facing out.

3. Laminated vapor barrier jackets are not required for flexible elastomeric foam insulation.

B. Canvas Jackets: Cotton duck, fire retardant, complying with NFPA 701, 4 oz/sq yd. or 6 oz/sq yd as specified.

C. Premolded PVC Fitting Jackets:

1. Constructed of high impact, UV resistant PVC.

a. ASTM D 1784, Class 14253-C.

b. Working Temperature: 0-150 degrees F.

2.3 ADHESIVES, MASTICS, AND SEALERS

A. Lagging Adhesive (Canvas Jackets): Childer's CP-50A, Epolux's Cadalag 336, Foster's 30-36.

B. Vapor Seal Adhesive (Fibrous Glass Insulation): Childers' CP-82, Epolux's Cadoprene 400, Foster's 85-75 or 85-20.

C. Vapor Barrier Mastic/Joint Sealer (Fibrous Glass Insulation): Childers' CP-30, Epolux's Cadalar 670, Foster's 95-44 or 30-35.

D. Adhesive (Flexible Elastomeric Foam): Armstrong's 520, Childers' CP-80, Epolux's Cadoprene 488, Foster's 82-40.

E. Adhesive (Reinforcing Membrane): Childers' Chil-Spray WB CP-56.

F. Mastic (Reinforcing Membrane): Childers' AK-CRYL CP-9.

G. Sealant (Metal Pipe Jacket): One-part silicone sealant for high temperatures; Dow Corning's Silastic 736 RTV or General Electric's RTV 106.

2.4 MISCELLANEOUS MATERIALS

A. Insulation Fasteners:

1. Acceptable Manufacturers: Duro-Dyne Corp.; Erico Fastening Systems, Inc.

2. Type: Weld pins, complete with self-locking insulation retaining washers.

B. Pressure Sensitive Tape for Sealing Laminated Jackets:

1. Acceptable Manufacturers: Alpha Associates, Childers, Ideal Tape, Morgan Adhesive.

2. Type: Same construction as jacket.

C. Wire, Bands, and Wire Mesh:

1. Binding and Lacing Wire: Nickel copper alloy or copper clad steel.

2. Bands: Galvanized steel, 1/2" wide x 0.015 inch thick, with 0.032 inch thick galvanized wing seals.

3. Wire Mesh: Woven 20 gage steel wire with 1 inch hexagonal openings, galvanized after weaving.

D. Reinforcing Membrane: Glass or Polyester, 10 x 10 mesh. Alpha Associates Style 59, Childers Chil-Glas, Foster's MAST-A-FAB.

PART 3 EXECUTION

3.1 PREPARATION

A. Perform the following prior to starting insulation Work:

1. Install all hangers, supports, and appurtenances in their permanent locations.

2. Complete testing of piping.

3. Clean and dry all surfaces to be insulated.

3.2 INSTALLATION, GENERAL

A. Install the Work of this Section in accordance with manufacturer's printed installation instructions unless otherwise specified.

B. All piping serving as part of a heating or cooling system shall be thermally insulated in accordance withe the New York State Energy Conservation Code and NAIMA National Insulation Standards.

C. Provide continuous piping insulation and jacketing when passing thru interior wall, floor, and ceiling construction.

1. At Through Penetration Firestops: Coordinate insulation densities with the requirements of approved firestop system being installed. See Section 23 0515.

a. Insulation densities required by approved firestop system may vary with the densities specified in this Section. When this occurs use the higher density insulation.

D. Individual piping runs shall have consistent insulation type.

E. Apply Insulation to completely cover entire surface of piping. Do not insulate over weld certification stamps.

3.3 INSTALLATION AT HANGERS AND SUPPORTS

A. Reset and realign hangers and supports if they are displaced during insulation installation.

B. Install high density jacketed insulation inserts at hangers and supports for insulated piping as specified.

1. Insulation Inserts For Use with Fibrous Glass Insulation:

a. Where insulation is subject to compression at points over 180 degrees apart, e.g. riser clamps, U-bolts, or trapezes, fully encircle pipe with 2 protection shields and 2 high density jacketed fibrous glass insulation inserts within supporting members.

1) Exception: Locations where pipe covering protection saddles are specified for hot service piping, 6 inch and larger.

2. Insulation Inserts For Use with Flexible Elastomeric Foam Insulation:

a. Where clevis hangers are used, install insulation shields with hardwood filler pieces, same thickness as adjoining insulation, inserted in undersized die cut or slotted holes in insulation at support points.

b. Where hardwood blocks are used, contour to match the curvature of pipe, and shield.

c. Coat dowels and blocks with insulation adhesive, and insert while sill wet.

d. Vapor seal outer surfaces of dowels and blocks with adhesive after insertion.

e. Provide minimum 2 dowels plugs or one filler block per hanger.

3.4 INSTALLATION OF FIBROUS GLASS HOT SERVICE INSULATION

A. Install insulation materials with field or factory applied ASTM C 1136 Type I laminated vapor barrier jacket unless otherwise specified.

B. Canvas Jackets on Piping, Fittings, Valves, Flanges, Unions, and Irregular Surfaces:

1. For piping 2 inch size and smaller: 4 oz per sq yd unless otherwise specified.

2. For piping over 2 inch size: 6 oz per sq yd unless otherwise specified.

C. Piping:

1. Butt insulation joints together.

2. Continuously seal joints with minimum 1-1/2 inch wide self-sealing longitudinal jacket laps and 3-inch wide butt adhesive backed strips, or 3 inch wide pressure sensitive sealing tape of same material as jacket.

3. Fill voids in insulation at hanger with insulating cement.

4. Exceptions:

a. Piping in Accessible Shafts, Attic Spaces, Crawl Spaces, Unfinished Spaces, and Concealed Piping: Butt insulation joints together and secure with minimum 1-1/2" wide longitudinal jacket laps and 3 inch wide butt strips of same material as jacket, with outward clinching staples on maximum 4 inch centers. Fill voids in insulation at hangers with insulating cement.

b. Piping in Tunnels: Butt insulation joints together and secure with minimum 1-1/2" wide longitudinal jacket laps and 3 inch wide butt strips, of same material as jacket, with outward clinching staples on maximum 4 inch centers and 16 gage wires a minimum of 4 loops per section. Fill voids in insulation with insulating cement.

5. Fittings, Valves, Flanges and Irregular Surfaces:

    a. Insulate with mitre cut or pre-molded fitting insulation of same material and thickness as adjoining pipe insulation.

    b. Secure insulation in place with 16 gage wire, with ends twisted and turned down into insulation.

    c. Butt fitting, valve, and flange insulation against pipe insulation and bond with insulating cement.

    d. Insulate valves up to and including bonnets, without interfering with packing nuts.

    e. Apply leveling coat of insulating cement to smooth out insulation and cover wiring.

    f. When insulating cement has dried, coat insulated surface with lagging adhesive, and apply 4 oz. or 6 oz. canvas jacket as required by pipe size.

        1) Lap canvas jacket on itself and adjoining pipe insulation at least 2 inches.

        2) Size entire canvas jacket with lagging adhesive.

    g. Exceptions:

        1) Insulate fittings, valves, and irregular surfaces 3 inch size and smaller with insulating cement covered with 4 oz or 6 oz canvas jacket as required by pipe size. Terminate pipe insulation adjacent to flanges and unions with insulating cement, troweled down to pipe on a bevel.

        2) Sizing of canvas surface is not required on fittings, valves, flanges, and irregular surfaces in concealed piping, piping in accessible shafts, attic spaces, crawl spaces, unfinished spaces, and tunnels.

6. Fittings, Valves, Flanges and Irregular Surfaces - Alternate:

    a. Apply one piece pre-molded PVC fitting covers with fibrous glass insulation inserts with galvanized coated tack fasteners. Tape circumferential joint between insulation and premolded fitting cover with 2 inch wide pressure sensitive polyvinyl tape.

        1) Exception: Provide additional insulation inserts on service operating at over 250 degrees F or where insulation thickness exceeds 1-1/2 inches. Ensure that insulation is adequate to prevent PVC fitting jacket temperature from exceeding 150 degrees F.

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC FOAM INSULATION

A. Slit insulation and install over pipe. Seal longitudinal and butt joints with adhesive.

B. Insulate fittings and valves with miter cut sections. Use templates provided by the manufacturer and assemble the cut sections in accordance with the manufacturer's printed instructions.

1. Insulate threaded fittings and valves with sleeved fitting covers. Over lap and seal the covers to the adjoining pipe insulation with adhesive.

C. Carefully mate and seal with adhesive all contact surfaces to maintain the integrity of the vapor barrier system.

D. Piping Exposed to the Elements:

1. Apply flexible elastomeric foam insulation to piping with adhesive.

2. Apply reinforcing membrane around piping insulation with adhesive or mastic.

3. Adhesive Applied System: Apply another coat of mastic over reinforcing membrane.

4. Mastic Applied System: Apply another coat of mastic over reinforcing membrane.

3.6 SCHEDULE OF PIPING AND EQUIPMENT INSULATION

A. Insulate all cold service and hot service piping, equipment, and appurtenances except were otherwise specified.

B. Hot Service Piping Insulation Schedule:

1. Heating Water/Glycol Supply and Return:

a. Fibrous Glass Insulation:

1) Up to and including 1-1/2 inch pipe size - Insulation thickness = 1-1/2 inch

2) Larger than 1-1/2 inch pipe size - Insulation thickness = 2 inch

C. Cold Service Piping Insulation Schedule:

1. Refrigerant Piping Insulation:

a. Flexible Elastomeric Insulation:

1) Up to and Including 1 inch pipe size - Insulation thickness = 1 inch.

2) 1-1/4 inch and larger pipe size - Insulation thickness = 1-1/2 inch.

3.7 PIPING INSULATION/JACKETING SCHEDULE

A. Insulation Schedule - Provide as indicated below.

1. Heating water supply and return.

a. Glass fiber insulation with all service jacket and pvc jacket.

1) PVC jacket not required for piping above suspended ceilings and inside pipe chases. In mechanical rooms (boiler rooms), storage rooms, etc. painted canvas jacket is acceptable.

2) PVC jacket is required for wet environments (Dewatering Building Mechanical Operations Room,).

END OF SECTION

SECTION 23 2113 - HYDRONIC PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Hydronic system requirements.

B. Heating water and glycol piping, above grade.

C. Pipe hangers and supports.

D. Unions, flanges, mechanical couplings, and dielectric connections.

E. Valves:

1. Ball valves.

2. Butterfly valves.

3. Check valves.

1.2 RELATED REQUIREMENTS

A. Section 23 0553 - Identification for HVAC Piping and Equipment.

B. Section 23 0719 - HVAC Piping Insulation.

C. Section 23 2114 - Hydronic Specialties.

1.3 REFERENCE STANDARDS

A. ASME BPVC-IX - Qualification Standard for Welding, Brazing, and Fuzing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators - Welding Brazing and Fusing Qualifications; 2019.

B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2021.

C. ASME B16.15 - Cast Copper Alloy Threaded Fittings Classes 125 and 250; 2013.

D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2021.

E. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.

F. ASME B16.34 - Valves - Flanged, Threaded and Welding End; 2017.

G. ASME B16.51 - Copper and Copper Alloy Press-Connect Pressure Fittings; 2021.

H. ASME B31.9 - Building Services Piping; 2020.

I. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2020.

J. ASTM A106/A106M - Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service; 2015.

K. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2019.

L. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).

M. ASTM B32 - Standard Specification for Solder Metal; 2020.

N. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2020.

O. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.

P. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2021a.

Q. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers; 1992, with Editorial Revision (2018).

R. ASTM F876 - Standard Specification for Crosslinked Polyethylene (PEX) Tubing; 2024.

S. ASTM F877 - Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems; 2024.

T. ASTM F1476 - Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications; 2007 (Reapproved 2019).

U. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011 (Amended 2012).

V. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020.

W. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings; 2021.

X. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast; 2023.

Y. AWWA C606 - Grooved and Shouldered Joints; 2022.

Z. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

1.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data:

1. Include data on pipe materials, pipe fittings, valves, and accessories.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.

PART 2 PRODUCTS

2.1 HYDRONIC SYSTEM REQUIREMENTS

A. Comply with ASME B31.9 and applicable federal, state, and local regulations.

B. Piping: Provide piping, fittings, hangers, and supports as required, as indicated, and as follows:

1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.

2. Use non-conducting dielectric connections whenever jointing dissimilar metals.

3. Grooved mechanical joints may be used in accessible locations only.

a. Accessible locations include those exposed on interior of building, in pipe chases, and in mechanical rooms, aboveground outdoors, and as approved by Engineer.

b. Grooved mechanical connections and joints comply with AWWA C606.

1) Ductile Iron: Comply with ASTM A536, Grade 65-45-12.

2) Steel: Comply with ASTM A106/A106M, Grade B or ASTM A53/A53M.

c. Use rigid joints unless otherwise indicated.

4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.

C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved couplings to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.

1. Where grooved joints are used in piping, provide grooved valve/equipment connections if available; if not available, provide flanged ends and grooved flange adapters.

D. Valves: Provide valves where indicated:

1. Provide drain valves where indicated, and if not indicated, provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch gate valves with cap; pipe to nearest floor drain.

2. Isolate equipment using butterfly valves with lug end flanges or grooved mechanical couplings.

3. For throttling, bypass, or manual flow control services, use globe, ball, or butterfly valves.

4. In heating water systems, butterfly valves may be used interchangeably with gate and globe valves.

5. For shut-off and to isolate parts of systems or vertical risers, use gate, ball, or butterfly valves.

2.2 HEATING WATER AND GLYCOL PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M, Schedule 40, black, using one of the following joint types:

1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.

2. Threaded Joints: ASME B16.3, malleable iron fittings.

3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.

B. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), drawn, using one of the following joint types:

1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.

a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.

b. Braze: AWS A5.8M/A5.8 BCuP copper/silver alloy.

2. Grooved Joints: AWWA C606 grooved tube, fittings of same material, and copper-tube-dimension mechanical couplings.

3. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.

4. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.51, utilizing EPDM, nontoxic synthetic rubber sealing elements.

2.3 PIPE HANGERS AND SUPPORTS

A. Provide hangers and supports that comply with MSS SP-58.

1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.

2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inches: Malleable iron, adjustable swivel, split ring.

3. Hangers for Cold Pipe Sizes 2 Inches and Greater: Carbon steel, adjustable, clevis.

4. Hangers for Hot Pipe Sizes 2 to 4 Inches: Carbon steel, adjustable, clevis.

5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

6. Vertical Support: Steel riser clamp.

7. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

8. Floor Support for Hot Pipe Sizes to 4 Inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

9. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

10. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

11. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

B. In grooved installations, use rigid couplings with offsetting angle-pattern bolt pads or with wedge-shaped grooves in header piping to permit support and hanging in accordance with ASME B31.9.

C. All pipe hangers and supports in wet locations(Dewatering Building Upper Level Mechanical Operations Room and Lower Level) shall have stainless steel support rods, stainless steel mounting hardware, stainless steel fasteners, and stainless steel concrete inserts. All non-stainless steel parts of the hangers and supports shall be PVC coated.

2.4 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

A. Unions for Pipe of 2 Inches and Less:

1. Ferrous Piping: 150 psi brass or malleable iron, threaded.

2. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe 2 Inches and Greater:

1. Ferrous Piping: 150 psig forged steel, slip-on.

2. Copper Piping: Bronze.

3. Gaskets: 1/16 inch thick, preformed neoprene.

C. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with continuous key to engage pipe groove, circular C-profile gasket, and bolts to secure and compress gasket.

1. Dimensions and Testing: In accordance with AWWA C606.

2. Mechanical Couplings: Comply with ASTM F1476.

3. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.

4. When pipe is field grooved, provide coupling manufacturer's grooving tools.

2.5 BALL VALVES

A. Up To and Including 2 Inches:

1. Bronze one piece body, chrome plated brass ball, teflon seats and stuffing box ring, lever handle with balancing stops, solder ends with union.

B. Over 2 Inches:

1. Ductile iron body, chrome plated stainless steel ball, teflon seat and stuffing box seals, lever handle, flanged ends, rated to 800 psi.

2.6 BUTTERFLY VALVES

A. Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer, lug, or grooved ends, extended neck.

B. Disc: Construct of aluminum bronze, chrome plated ductile iron, stainless steel, ductile iron with EPDM encapsulation, or Buna-N encapsulation.

C. Operator: 10 position lever handle.

2.7 SWING CHECK VALVES

A. Up To and Including 2 Inches:

1. Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder or threaded ends.

B. Over 2 Inches:

1. Iron body, bronze trim, stainless steel, bronze, or bronze faced rotating swing disc, renewable disc and seat, flanged or grooved ends.

2.8 SPRING LOADED CHECK VALVES

A. Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer, or threaded lug ends.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Prepare pipe for grooved mechanical joints as required by coupling manufacturer.

C. Remove scale and dirt on inside and outside before assembly.

D. Prepare piping connections to equipment using jointing system specified.

E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

F. After completion, fill, clean, and treat systems. See Section 23 2500 for additional requirements.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install heating water, glycol, chilled water, condenser water, and engine exhaust piping to ASME B31.9 requirements.

C. Route piping in orderly manner, parallel to building structure, and maintain gradient.

D. Install piping to conserve building space and to avoid interference with use of space.

E. Group piping whenever practical at common elevations.

F. Sleeve pipe passing through partitions, walls, and floors.

G. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified.

H. Slope piping and arrange to drain at low points.

I. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 23 0516.

J. Grooved Joints:

1. Install in accordance with the manufacturer's latest published installation instructions.

2. Gaskets to be suitable for the intended service, molded, and produced by the coupling manufacturer.

K. Pipe Hangers and Supports:

1. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58.

2. Support horizontal piping as scheduled.

3. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.

3.3 SCHEDULES

A. Hanger Spacing for Copper Tubing.

1. 1/2 Inch and 3/4 inch: Maximum span, 5 feet; minimum rod size, 1/4 inch.

2. 1 Inch: Maximum span, 6 feet; minimum rod size, 1/4 inch.

3. 1-1/2 Inches and 2 Inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.

B. Hanger Spacing for Steel Piping.

1. 1/2 Inch, 3/4 Inch, and 1 Inch: Maximum span, 7 feet; minimum rod size, 1/4 inch.

2. 1-1/4 Inches: Maximum span, 8 feet; minimum rod size, 3/8 inch.

3. 1-1/2 Inches: Maximum span, 9 feet; minimum rod size, 3/8 inch.

4. 2 Inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.

END OF SECTION

SECTION 23 2114 - HYDRONIC SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Expansion tanks.

B. Air vents.

C. Air separators.

D. Strainers.

E. Triple Duty Valves.

F. Balancing valves.

G. Relief valves.

1.2 RELATED REQUIREMENTS

A. Section 23 2113 - Hydronic Piping.

1.3 REFERENCE STANDARDS

A. ASME (BPV VIII, 1) - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; The American Society of Mechanical Engineers; 2007.

1.4 SUBMITTALS

A. Product Data: Manufacturer's catalog sheets, specifications, and installation instructions for all items specified.

PART 2 PRODUCTS

2.1 BLADDER-TYPE EXPANSION TANKS

A. Manufacturers:

1. ITT Bell & Gossett.

2. John Wood Company.

3. Taco, Inc.

4. Approved Equal.

B. Construction: Welded steel, tested and stamped in accordance with ASME (BPV VIII, 1); supplied with National Board Form U-1, rated for working pressure of 125 psi, with replaceable heavy duty butyl rubber bladder, and steel support stand.

C. Accessories: Pressure gage and air-charging fitting, tank drain; precharge to 12 psi.

D. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure back flow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.

2.2 AIR VENTS

A. Manufacturers:

1. ITT Bell & Gossett.
2. John Wood Company.
3. Taco, Inc.
4. Approved Equal.

B. Manual Type: Provide manual vent air vent valves designed to be operated manually with a screw driver or thumbscrew and 1/8" NPT connection.

C. Automatic Type: Provide float type automatic air vent valves with cast iron body, stainless steel float and mechanisms, pressure rated for 125 psi, with 1/2" NPT connections.

2.3 AIR SEPARATORS

A. In-line Air Separators:

1. Manufacturers:
   a. ITT Bell & Gossett.
   b. John Wood Company.
   c. Taco, Inc.
   d. Approved Equal.
2. Cast iron for sizes 1-1/2 inch and smaller, or steel for sizes 2 inch and larger; tested and stamped in accordance with ASME (BPV VIII, 1); for 125 psi operating pressure.

B. Combination Air Separators/Strainers:

1. Manufacturers:

    a. ITT Bell & Gossett.

    b. Armstrong International, Inc.

    c. Taco, Inc.

    d. Approved Equal.

2. Steel, tested and stamped in accordance with ASME (BPV VIII, 1); for 125 psi operating pressure, with integral bronze strainer, tangential inlet and outlet connections, and internal stainless steel air collector tube.

2.4 STRAINERS

A. Manufacturers:

1. Armstrong International, Inc.

2. Green Country Filtration.

3. WEAMCO.

4. Approved Equal.

B. Size 2 inch and Under:

1. Screwed brass or iron body for 175 psi working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

C. Size 2-1/2 inch to 4 inch:

1. Flanged iron body for 175 psi working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

2.5 SUCTION DIFFUSERS

A. Manufacturers:

1. ITT Bell & Gossett.

2. Armstrong International Inc.

3. Taco, Inc.

4. Approved Equal.

B. Fitting: Angle pattern, cast-iron body, threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger, rated for 175 psi working pressure. Provide full length flow straightening

vanes of length no less than 2-1/2 times the pump suction diameter to provide nonturbulent flow to the pump suction. Diffuser shall have stainless steel combination diffuser-strainer-orifice cylinder with 3/16 inch diameter openings designed to withstand pressure equal to pump shut-off head, and disposable fine mesh strainer to fit over cylinder strainer.

C. Accessories: Adjustable foot support, blowdown tapping in bottom, gage tapping in side.

2.6 TRIPLE DUTY VALVES

A. Manufacturers:

1. ITT Bell & Gossett.
2. Armstrong International Inc.
3. Taco, Inc.
4. Approved Equal.

B. Valves: Straight or angle pattern, flanged cast-iron valve body with bolt-on bonnet for 175 psi operating pressure, non-slam check valve with spring-loaded bronze disc and seat, stainless steel stem, and calibrated adjustment permitting flow regulation.

2.7 AUTOMATIC BALANCING VALVES

A. General:

1. Use automatic flow control valves on all heating applications of 180 GPM or less.

B. Manufacturers:

1. ITT Bell & Gossett.
2. Approved Equal.

C. Construction: Brass or bronze body with union on inlet and outlet, temperature and pressure test plug on inlet and outlet with blowdown/backflush drain, with integral automatic flow rate cartridge. EPDM O-rings.

D. Calibration: Automatically control flow within 5 percent of selected rating, over operating differential pressure range 2 to 60 psi.

E. Control Mechanism: Stainless steel or nickel plated brass piston or regulator cup, operating against stainless steel helical or wave formed spring.

F. Accessories: In-line strainer on inlet and ball valve on outlet.

2.8 BALANCING VALVES

A. Manufacturers:

1. ITT Bell & Gossett.
2. Armstrong International Inc.
3. Taco, Inc.
4. Approved Equal.

B. General:

1. Valves shall have memory stop feature to allow valve to be closed for service and re-opened to set point without disturbing balance position. Valves shall have calibrated nameplate to assure specific valves setting.
2. Design Pressure/Temperature:
    a. 3/4"-3" NPT connections: 300 psig at 250 degrees F.
    b. 3/4"-2" Sweat connections: 200 psig at 250 degrees F.
    c. 2-1/2"-3" Flanged connections: 175 psig at 250 degrees F.
    d. 4"-12" Flanged or grooved connections: 175 psig at 250 degrees F.

C. Valves 3/4" to 2" Pipe size: NPT or Sweat; Valves 2-1/2" to 3" Pipe size: NPT.

1. Valves shall be of bronze body/brass ball construction with glass and carbon filled TFE seat rings. Valves shall have differential pressure read-out ports fitted with check valves across valve seat area. Valve body shall have 1/4" NPT tapped drain/purge port.

D. Valves 2-1/2" to 3" Pipe size: Flanged

1. Valves shall be of heavy duty cast iron construction with brass ball with glass and carbon filled TFE seat rings. 125 psi ANSI flanged connections shall be suitable for up to 175 psi working pressure. Valves shall have differential pressure read-out ports fitted with check valves across valve seat area.

2.9 RELIEF VALVES

A. Manufacturers:

1. ITT Bell & Gossett.
2. Armstrong International, Inc.

3. Myson Company.

4. Approved Equal.

B. Bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, capacities ASME certified and labelled.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install specialties in accordance with manufacturer's instructions.

B. Provide manual air vents at system high points and as indicated.

C. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.

D. Provide air separator on discharge side of system circulation pump and connect to expansion tank.

E. Provide valved drain and hose connection on strainer blow down connection.

F. Support pump fittings with floor mounted pipe and flange supports.

G. Provide relief valves on pressure tanks, low pressure side of reducing valves, heat exchangers, and expansion tanks.

H. Select system relief valve capacity so that it is greater than make-up pressure reducing valve capacity. Select equipment relief valve capacity to exceed rating of connected equipment.

I. Pipe relief valve outlet to nearest floor drain.

J. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.

END OF SECTION

SECTION 23 2123 - HYDRONIC PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. In-line pumps.

1.2 RELATED REQUIREMENTS

A. Section 23 2113 - Hydronic Piping.

B. Section 23 2114 - Hydronic Specialties.

1.3 REFERENCE STANDARDS

A. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association; 2009, Revision 1 - 2010.

B. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; National Electrical Manufacturers Association; 2008.

C. NFPA 70 - National Electrical Code; National Fire Protection Association; 2008.

D. UL 778 - Standard for Motor-Operated Water Pumps; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

E. ASHRAE 90.1-2010- American Society of Heating, Refrigeration and Air Conditioning Engineers.

F. New York State Energy Code; Current Adopted Version.

1.4 SUBMITTALS

A. Product Data: Manufacturer's pump characteristic performance curves with system operating point plotted. Include NPSH curve, variable speed system curves, and parallel pumping curves when applicable. Manufacturer's pump specifications, installation, and start-up instructions. Include electrical characteristics and connection requirements.

B. Contract Close Out Submittals:

1. Operation and Maintenance Data: Include maintenance data, assembly views, lubrication instructions, and replacement parts list. Deliver 2 copies for each type of pump to the Owner's Representative.

1.5 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by UL and NEMA as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.1 IN-LINE PUMPS

A. Manufacturers:

1. ITT Bell & Gossett.
2. Armstrong Pumps Inc.
3. Taco Inc.
4. Approved Equal.

B. General: Provide long coupled in-line circulator pumps of sizes, capacities, and characteristics as scheduled on drawings.

C. Type: Horizontal shaft, single stage, vertical split case, oil lubricated, designed for 175 psi working pressure at 225 degrees F operating temperature.

D. Casing: Cast iron, bronze fitted, with flanged pump connections and suction and discharge gauge ports.

E. Impeller: Cast bronze keyed to shaft, hydraulically and dynamically balanced.

F. Bearings: Oil-lubricated bronze.

G. Shaft: Hardened alloy steel with non-ferrous sleeve.

H. Seal: Internally flushed mechanical seal, with cabon seal rotating against a stationary ceramic seat, suitable for continuous operation at 225 degrees F.

I. Drive: Self aligning flexible coupling.

J. Motor: Non-overloading at any point on pump curve, open drip-proof, oil-lubricated journal bearings, resilient mounted construction through 1 HP, rigid mounted 1-1/2 HP and over, built-in thermal overload protection on single phase motors.

1. Motors shall be NEMA High Efficiency with minimum nominal efficiencies complying with ASHRAE Standard 90.1-2010. Efficiencies shall be determined in accordance with NEMA standard MG1.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.2 INSTALLATION

A. Install in accordance with manufacturer's written instructions with recommended clearances for maintenance.

B. Provide line sized shut-off valves on pump discharge and suction. Provide piping and pump accessories, hangers, supports, anchors, valves, gauges, vibration isolation, and flexible metal connectors on all pumps as required for a complete system.

C. Provide air cock and drain connection on horizontal pump casings.

D. Check alignment, and where necessary, realign shafts of motors and pumps within recommended tolerances by manufacturer. Check and realign in presence of manufacturer's service representative. Check, align, and certify alignment of base mounted pumps prior to start-up.

E. Install in line pumps supported from piping system with access for maintennace.

F. Ensure that pumps are wired properly, grounding has been provided, and motors are rotating in correct direction prior to pump start-up.

G. Lubricate pumps before start-up. Start-up in accordance with manufacturer's written instructions.

END OF SECTION

SECTION 23 2300 - REFRIGERANT PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping.

B. Refrigerant.

C. Moisture and liquid indicators.

D. Valves.

E. Strainers.

F. Check valves.

G. Pressure relief valves.

H. Filter-driers.

I. Solenoid valves.

J. Expansion valves.

K. Flexible connections.

1.2 RELATED REQUIREMENTS

A. Section 23 0719 - HVAC Piping Insulation.

1.3 REFERENCE STANDARDS

A. AHRI 750 - Standard for Thermostatic Refrigerant Expansion Valves; 2007.

B. AHRI 760 (I-P) - Performance Rating of Solenoid Valves for Use with Volatile Refrigerants; 2014.

C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems and Designation and Classification of Refrigerants ; 2019, with Errata (2020).

D. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.

E. ASME B31.5 - Refrigeration Piping and Heat Transfer Components; 2013.

F. ASME B31.9 - Building Services Piping; 2020.

G. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2020.

H. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.

I. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2020.

J. AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding; 2011 (Amended 2012).

K. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

L. UL 429 - Electrically Operated Valves; Current Edition, Including All Revisions.

1.4 SUBMITTALS

A. Product Data: Provide general assembly of specialties, including manufacturers catalogue information. Provide manufacturers catalog data including load capacity.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store piping and specialties in shipping containers with labeling in place.

B. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

C. Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Filter-Driers:

1. Use a filter-drier immediately ahead of liquid-line controls, such as thermostatic expansion valves, solenoid valves, and moisture indicators.

2.2 REGULATORY REQUIREMENTS

2.3 PIPING

A. Copper Tube: ASTM B280, H58 hard drawn or O60 soft annealed.

1. Fittings: ASME B16.22 wrought copper.

2. Joints: Braze, AWS A5.8M/A5.8 BCuP silver/phosphorus/copper alloy.

B. Copper Tube to 7/8-inch OD: ASTM B88 (ASTM B88M), Type K (A), annealed.

C. Pipe Supports and Anchors:

1. Provide hangers and supports that comply with MSS SP-58.

a. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.

2. Hangers for Pipe Sizes 1/2 to 1-1/2 Inch: Malleable iron adjustable swivel, split ring.

3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.

4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.

6. Vertical Support: Steel riser clamp.

7. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

8. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

9. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 REFRIGERANT

2.5 MOISTURE AND LIQUID INDICATORS

A. Indicators: Single port type, UL listed, with copper or brass body, flared or soldered ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F and maximum working pressure of 500 psi.

2.6 VALVES

A. Diaphragm Packless Valves:

1. UL listed, globe or angle pattern, forged brass body and bonnet, phosphor bronze and stainless steel diaphragms, rising stem and handwheel, stainless steel spring, nylon seat disc, soldered or flared ends, with positive backseating; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.

B. Packed Angle Valves:

1. Forged brass or nickel plated forged steel, forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, soldered or flared ends; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.

C. Ball Valves:

1. Two piece bolted forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi and maximum temperature of 300 degrees F.

D. Service Valves:

1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or soldered ends, for maximum pressure of 500 psi.

2.7 STRAINERS

A. Straight Line or Angle Line Type:

1. Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psi.

2.8 CHECK VALVES

A. Globe Type:

1. Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc; for maximum temperature of 300 degrees F and maximum working pressure of 425 psi.

B. Straight Through Type:

1. Brass body and disc, phosphor-bronze or stainless steel spring, neoprene seat; for maximum working pressure of 500 psi and maximum temperature of 200 degrees F.

2.9 PRESSURE RELIEF VALVES

A. Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB, selected to ASHRAE Std 15, with standard setting of 235 psi.

2.10 FILTER-DRIERS

A. Cores: Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, activated charcoal, and filtration to 40 microns, with secondary filtration to 20 microns; of construction that will not pass into refrigerant lines.

B. Construction: UL listed.

1. Connections: As specified for applicable pipe type.

2.11 SOLENOID VALVES

A. Valve: AHRI 760 (I-P), pilot operated, copper, brass or steel body and internal parts, synthetic seat, stainless steel stem and plunger assembly (permitting manual operation in case of coil failure), integral strainer, with flared, soldered, or threaded ends; for maximum working pressure of 500 psi.

B. Coil Assembly: UL 429, UL listed, replaceable with molded electromagnetic coil, moisture and fungus proof, with surge protector and color coded lead wires, integral junction box with pilot light.

2.12 EXPANSION VALVES

A. Angle or Straight Through Type: AHRI 760 (I-P); design suitable for refrigerant, brass body, internal or external equalizer, bleed hole, adjustable superheat setting, replaceable inlet strainer, with nonreplaceable capillary tube and remote sensing bulb and remote bulb well.

B. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F superheat. Select to avoid being undersized at full load and excessively oversized at part load.

2.13 FLEXIBLE CONNECTORS

A. Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9 inches long with copper tube ends; for maximum working pressure of 500 psi.

PART 3 EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

A. Install refrigeration specialties in accordance with manufacturer's instructions.

B. Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.

C. Install piping to conserve building space and avoid interference with use of space.

D. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

E. Inserts:

1. Provide inserts for placement in concrete formwork.

2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

F. Pipe Hangers and Supports:

1. Install in accordance with ASME B31.5.

2. Support horizontal piping as indicated.

G. Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.

H. Provide clearance for installation of insulation and access to valves and fittings.

I. Provide access to concealed valves and fittings.

J. Flood piping system with nitrogen when brazing.

K. Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.

L. Prepare unfinished pipe, fittings, supports, and accessories ready for finish painting. See Section 09 9123.

M. Insulate piping.

N. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.

O. Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.

P. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.

Q. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.

R. Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.

S. Fully charge completed system with refrigerant after testing.

T. Provide electrical connection to solenoid valves. See Section 26 2717.

3.3 FIELD QUALITY CONTROL

A. Test refrigeration system in accordance with ASME B31.5.

B. Pressure test system with dry nitrogen to 200 psi. Perform final tests at 27 inches vacuum and 200 psi using halide torch. Test to no leakage.

3.4 SCHEDULES

A. Hanger Spacing for Copper Tubing.

1. 1/2 inch, 5/8 inch, and 7/8 inch OD: Maximum span, 5 feet; minimum rod size, 1/4 inch.

2. 1-1/8 inch OD: Maximum span, 6 feet; minimum rod size, 1/4 inch.

3. 1-3/8 inch OD: Maximum span, 7 feet; minimum rod size, 3/8 inch.

4. 1-5/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.

5. 2-1/8 inch OD: Maximum span, 8 feet; minimum rod size, 3/8 inch.

6. 2-5/8 inch OD: Maximum span, 9 feet; minimum rod size, 3/8 inch.

7. 3-1/8 inch OD: Maximum span, 10 feet; minimum rod size, 3/8 inch.

8. 3-5/8 inch OD: Maximum span, 11 feet; minimum rod size, 1/2 inch.

9. 4-1/8 inch OD: Maximum span, 12 feet; minimum rod size, 1/2 inch.

END OF SECTION

SECTION 23 3100 - HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal ducts.

B. Nonmetal ducts.

1.2 RELATED REQUIREMENTS

A. Section 23 0713 - Duct Insulation: External insulation and duct liner.

B. Section 23 3300 - Air Duct Accessories.

C. Section 23 3700 - Air Outlets and Inlets: Fabric air distribution devices.

1.3 REFERENCE STANDARDS

A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; 2013.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

D. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021.

E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.

F. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005.

1.4 SUBMITTALS

A. Product Data: Provide data for duct materials.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Provide UL Class 1 ductwork, fittings, hangers, supports, and appurtenances in accordance with NFPA 90A and SMACNA (DCS) guidelines unless stated otherwise.

B. Duct Fabrication Requirements:

1. Duct and Fitting Fabrication and Support: SMACNA (DCS) including specifics for continuously welded round and oval duct fittings.

2. Use reinforced and sealed sheet-metal materials at recommended gauges for indicated operating pressures or pressure class.

3. Construct tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide airfoil turning vanes of perforated metal with glass fiber insulation.

4. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.

5. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

6. Provide turning vanes of perforated metal with glass fiber insulation when an acoustical lining is required.

7. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

C. General Exhaust: 1 inch w.g. pressure class.

D. Outside Air Intake: 1 inch w.g. pressure class.

2.2 MATERIALS

A. Hanger Rod: ASTM A36/A36M; steel, galvanized; stainless steel where corrosion resistance is required (as specified on drawings); threaded both ends, threaded one end, or continuously threaded.

2.3 METAL DUCTS

A. Material Requirements:

1. Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.

2. Aluminum: ASTM B209/B209M, aluminum sheet, alloy 3003-H14.

3. Aluminum Connectors and Bar Stock: Alloy 6061-T651 or of equivalent strength.

4. Stainless Steel: ASTM A666, Type 316.

2.4 NON-METAL DUCTS

A. Thermoset Fiber Glass Reinforced Plastic (FRP) Ducts:

1. Glass fiber reinforced plastic with minimum wall thickness of 3/16 inch.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA (DCS).

B. Install products following the manufacturer's instructions.

C. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering the ductwork system.

D. Duct sizes indicated are precise inside dimensions. For lined ducts, maintain sizes inside lining.

E. Provide openings in ductwork as indicated to accommodate thermometers and controllers. Provide pilot tube openings as indicated for testing of systems, complete with metal can with spring device or screw to insure against air leakage. For openings, insulate ductwork and install insulation material inside a metal ring.

F. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

G. Connect terminal units to supply ducts directly or with one foot maximum length of flexible duct. Do not use flexible duct to change direction.

H. Connect diffusers or light troffer boots to low-pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.

END OF SECTION

SECTION 23 3300 - AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air turning devices/extractors.

B. Duct access doors.

C. Flexible duct connectors.

D. Volume control dampers.

E. Fiberglass control dampers.

F. Low leakage (Class 1A) control dampers.

1.2 RELATED REQUIREMENTS

A. Section 23 3100 - HVAC Ducts and Casings.

1.3 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.

B. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.

C. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005.

1.4 SUBMITTALS

A. Product Data: Provide for shop-fabricated assemblies including volume control dampers. Include electrical characteristics and connection requirements.

PART 2 PRODUCTS

2.1 AIR TURNING DEVICES/EXTRACTORS

A. Manufacturers:

1. Carlisle HVAC Products; Dynair Hollow Vane and Rail (Double Wall Vane): www.carlislehvac.com.

2. Krueger: www.krueger-hvac.com.

3. Ruskin Company: www.ruskin.com.

4. Titus: www.titus-hvac.com.

5. Approved Equal.

B. Multi-blade device with blades aligned in short dimension; steel or aluminum construction (match duct construction); with individually adjustable blades, mounting straps.

2.2 DUCT ACCESS DOORS

A. Manufacturers:

1. Acudor Products Inc: www.acudor.com.

2. Elgen Manufacturing: www.elgenmfg.com.

3. Nailor Industries Inc: www.nailor.com.

4. Ruskin Company: www.ruskin.com.

5. Approved Equal.

B. Fabricate in accordance with SMACNA (DCS) and as indicated.

2.3 FLEXIBLE DUCT CONNECTORS

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. Flexible Duct Connections: Fabric crimped into metal edging strip.

2.4 VOLUME CONTROL DAMPERS

A. Manufacturers:

1. Louvers & Dampers, Inc: www.louvers-dampers.com.

2. Nailor Industries Inc: www.nailor.com.

3. Ruskin Company: www.ruskin.com.

4. Approved Equal.

B. Fabricate in accordance with SMACNA (DCS) and as indicated.

C. Single Blade Dampers:

1. Fabricate for duct sizes up to 6 by 30 inch.

2. Blade: 24 gauge, 0.0239 inch, minimum.

D. Multi-Blade Damper: Fabricate consisting of opposed blades with maximum blade sizes 8 by 72 inch. Assemble center- and edge-crimped blades in prime-coated or galvanized steel/aluminum channel/stainless steel (match duct material) frame with suitable hardware.

1. Blade: 18 gauge, 0.0478 inch, minimum.

2.5 FIBERGLASS CONTROL DAMPERS

A. Fiberglass Material Construction: ASTM E84, flame retardant, vinyl ester based resin.

2.6 LOW LEAKAGE (CLASS 1A) CONTROL DAMPERS

A. Maximum Leakage Allowed: 3 cfm/sq ft at 1 in-wc.

B. Frame:

1. Material: 12 gauge match duct material.

2. Free-area: Single cross section.

C. Blade:

1. Type: Single-blade rectangle shape.

2. Operation: Opposed type.

3. Maximum Individual Blade Height: 8 inches.

4. Material: 12 gauge match duct material.

D. Insulation: Water-resistant sound absorbing material.

E. Temperature Service Range: Minus 25 to 185 degrees F.

F. Other Requirements:

1. Paint Finish: Standard.

2. Sleeve or Flange: Factory-mounted standard.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). See Section 23 3100 for duct construction and pressure class.

B. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide minimum 8 by 8 inch size for hand access, size for shoulder access, and as indicated. Provide 4 by 4 inch for balancing dampers only. Review locations prior to fabrication.

C. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.

D. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.

E. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum two duct widths from duct take-off.

F. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 23 3416 - CENTRIFUGAL HVAC FANS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Roof Mounted Exhaust Fans.

B. Wall Mounted Exhaust Fans.

C. Cabinet exhaust Fans.

D. Centrifugal In-line Fans.

1.2 RELATED SECTIONS

A. Section 233100 - HVAC Ducts and Casings.

B. Section 233300 - Air Duct Accessories.

1.3 REFERENCES

A. AMCA 99 - Standards Handbook; Air Movement and Control Association International, Inc.; 2003.

B. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating; Air Movement and Control Association International, Inc.; 1999 (ANSI/AMCA 210, same as ANSI/ASHRAE 51).

C. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; Air Movement and Control Association International, Inc.; 1990.

D. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association; 2003.

E. UL 705 - Power Ventilators; Underwriters Laboratories Inc.; 2004.

1.4 SUBMITTALS

A. Product Data: Manufacturer's catalog sheets, standard schematic drawings, specifications, and installation instructions for each size unit and curb.

1. Provide fan curves with specified operating point clearly plotted.

B. Contract Closeout Submittals:

1. Operation and Maintenance Data: Deliver 2 copies covering the installed products to the Owner's Representative.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Fans shall be licensed to bear the AMCA seal.

2. All electrical components shall be UL listed.

PART 2 PRODUCTS

2.1 **ROOF MOUNTED EXHAUST FANS**

A. Manufacturers:

1. Greenheck.

2. Loren Cook Company.

3. Hartzell Fan Corporation.

4. Approved Equal.

B. General: Powered roof exhausters shall be of the electric motor centrifugal fan type, V-belt or direct drive as scheduled on drawings. Fans shall be enclosed in a storm proof aluminum housing, properly braced and stiffened to form a rigid unit.

C. Housing: Fabricate from spun aluminum with bolted and welded construction utilizing corrosion resistant fasteners. Top cap shall be of two piece construction with stainless steel quick release latches to permit access to motor compartment. Provide structural reinforcing members to support fan wheel, motor and bearings, and vibration eliminating devices to prevent transmission of vibration to housing.

D. Fan Assembly:

1. Fan Wheel: Non-overloading backward inclined, spark-resistant centrifugal type, fabricated from aluminum balanced at the factory in accordance with AMCA Standard 204-96.

2. Drive Assembly: Direct or Belt drive as indicated on Drawings.

a. Direct Drive: Electric motor direct drive.

b. Belt Drive: Electric motor driven V belt drive, with cast iron or steel pulleys, sized for 150% of rated horsepower at maximum speed.. Provide motor pulley of the variable pitch type, factory set at the design fan RPM at mid-position.

3. Bearings: Heavy duty regreasable ball type in a cast iron pillow block housing designed specifically for air handling equipment and selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

4. Motor: Heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase, and enclosure. Factory installed wiring shall be in a flexible metal conduit or integral conduit chase.

E. Damper: Automatic self-closing back draft type, with spring actuated return. Fabricate frame and blades from aluminum, with bearings of bronze or nylon. Damper blades shall be coupled together with tie rods at each end and shall have felted edges.

F. Nameplate: Engraved aluminum indicating manufacturer's model number, serial number, and equipment name to match unit tag as identified on drawings.

G. Accessories:

1. Disconnect Switch: Factory installed and wired non-fused disconnect switch, located under fan housing.

2. Birdscreen: Aluminum wire mesh birdscreen on discharge openings.

3. Roof Curb: 12 inch high self-flashing of galvanized steel with integral fiberglass insulation, continuously welded seams, built-in cant strips and curb seal.

4. Damper: Provide 120 volt automatic air damper in lieu of gravity damper were indicated on drawings. Include line voltage motor drive, power open, spring return.

5. Speed Control: On direct drive models, provide factory installed and wired solid state variable speed controller.

2.2 WALL MOUNTED EXHAUST FANS

A. Manufacturers:

1. Greenheck.

2. Loren Cook Company.

3. Hartzell Fan Corporation.

4. Approved Equal.

B. General: Powered wall exhausters shall be of the electric motor centrifugal fan type, V-belt or direct drive as scheduled on drawings. Fans shall be enclosed in a storm proof aluminum housing, properly braced and stiffened to form a rigid unit.

C. Housing: Fabricate from spun aluminum with bolted and welded construction utilizing corrosion resistant fasteners. Top cap shall be of two piece construction with stainless

steel quick release latches to permit access to motor compartment. Wall flange shall be constructed of spun aluminum and have pre-punched keyslot holes and a mounting template with wall opening location. Provide structural reinforcing members to support fan wheel, motor and bearings, and vibration eliminating devices to prevent transmission of vibration to housing.

D. Fan Assembly:

1. Fan Wheel: Non-overloading, backward inclined, spark-resistant centrifugal type, fabricated from aluminum balanced at the factory in accordance with AMCA Standard 204-96.

2. Drive Assembly: Direct or Belt drive as indicated on Drawings.

a. Direct Drive: Electric motor direct drive.

b. Belt Drive: Electric motor driven V belt drive, with cast iron or steel pulleys, sized for 150% of rated horsepower at maximum speed. Provide motor pulley of the variable pitch type, factory set at the design fan RPM at mid-position.

3. Bearings: Heavy duty regreasable ball type in a cast iron pillow block housing designed specifically for air handling equipment and selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

4. Motor: Heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase, and enclosure. Factory installed wiring shall be in a flexible metal conduit or integral conduit chase.

E. Damper: Automatic self-closing back draft type, with spring actuated return. Fabricate frame and blades from aluminum, with bearings of bronze or nylon. Damper blades shall be coupled together with tie rods at each end and shall have felted edges.

F. Nameplate: Engraved aluminum indicating manufacturer's model number, serial number, and equipment name to match unit tag as identified on drawings.

G. Accessories:

1. Disconnect Switch: Factory installed and wired non-fused disconnect switch, located under fan housing.

2. Birdscreen: Aluminum wire mesh birdscreen on discharge openings.

3. Damper: Provide 120 volt automatic air damper in lieu of gravity damper were indicated on drawings. Include line voltage motor drive, power open, spring return.

4. Speed Control: On direct drive models, provide factory installed and wired solid state variable speed controller.

2.3 WALL MOUNTED FANS - PROPELLER TYPE

A. Manufacturers:

1. Greenheck
2. Loren Cook Company.
3. Hartzell Fan Corporation.
4. Approved Equal.

B. General: Fan shall be a wall mounted, direct driven, propeller exhaust fan.

C. Construction: Fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The motor shall be mounted on a 14 Ga. Steel mounting plate and power assembly. The power assembly shall be bolted to a minimum 14 Ga. steel wall panel with continuously welded corners and an integral venturi. Unit shall bear an engraved aluminum nameplate. Nameplate shall indicate design CFM and static pressure.

D. Coating: All steel fan components shall be Lorenized™ with an electrostatically applied, baked polyester powder coating. Each component shall be subject to a five stage environmentally friendly wash system, followed by a minimum 2 mil thick baked powder finish. Paint must exceed 1,000 hour salt spray under ASTM B117 test method.

E. Propeller: Propeller shall be cast aluminum airfoil design with cast aluminum hub. The blade pitch shall be factory set and locked using set screws and roll pin. The hub shall be keyed and locked to the shaft utilizing two set screws or a taper lock bushing. Propeller shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.

F. Motor: Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure.

2.4 CABINET EXHAUST FANS

A. Manufacturers:

1. PennBarry.
2. Loren Cook Company.
3. Hartzell Fan Corporation.
4. Approved Equal.

B. General: Fans shall be of the electric motor direct driven centrifugal type, installed in a galvanized sheet steel unit casing, with electric terminal box inside housing, Include a decorative air intake grille and outside wall cap where indicated on Drawings.

1. Fan Assembly:

    a. Fan Housing: Fan wheel housing and integral outlet duct shall be injection molded from polypropylene resin, or manufactured from sheet steel with corrosion resistant coating. Integral motor mounting shall be stamped galvanized steel with vibration isolation mounts.

    b. Fan Wheel: Centrifugal forward curved type, injection molded from polypropylene resin, or manufactured from sheet steel with corrosion resistant coating. Wheel shall be balanced at the factory in accordance with AMCA Standard 204-96.

    c. Motor: Low speed (1200 RPM or below), with built-in thermal overload protection. Assembly shall be complete with flexible electric cord, plug and electrical receptacle inside housing. Suitably ground fan motor.

2. Unit Casing: Fabricate from heavy gage sheet steel, with a corrosion resistant coating. Provide discharge outlet complete with backdraft damper.

3. Accessories:

    a. Inlet Air Grille:

        1) Aluminum: Primed and finished with baked-on white enamel

    b. Speed Control: Solid state circuitry, with polished chromium plated wall plate, suitable for use with standard electrical wall box.

2.5 CENTRIFUGAL IN-LINE FANS

A. Manufacturers:

1. PennBarry.

2. Loren Cook Company.

3. Hartzell Fan Corporation.

4. Approved Equal.

B. General:

1. Fans shall be of size, arrangement, type, capacity, motor location, discharge location, rotation and constructed for Class 1 operating limits, unless otherwise indicated. Fans shall be non-overloading, backward curved type.

2. Backward Curved Fans:

    a. General: Fabricate housings from heavy gage aluminum, properly reinforced and supported to prevent breathing and vibration at all speed. Blades, shrouds and center plates shall be fabricated from sheet steel,

with the blades die formed and welded or riveted in place. Provide close grained cast iron hubs, securely riveted to the center plate. Shafts shall be steel, accurately turned, of ample diameter to prevent whipping, with precision bearings of the self-aligning, grease packed pillow block type, complete with grease seal. Statically and dynamically balance fan wheels at factory in accordance with AMCA Standard 204-96.

b. Fan Housings: Fabricate scrolls, sides and inlet cones from sheet steel, with angle bracing on housings. Provide a clean out door in scroll. Access doors shall be pan type, with inner surface flush with scroll and the rim secured to the frame on the scroll with hand grip bolts. Raised frame on scroll and door shall be suitable for installation of insulation, when specified.

3. Fan Shafts: Fabricate shafts from hot rolled or forged steel, extended on bearing end, to permit mounting of fan pulley, with end of shaft countersunk. Fan shafts shall be turned, ground, polished, and rust protected.

4. Bearings: Ball, roller or taper grease packed type, as required, rated for a minimum L50 life exceeding 200,000 hours. Provide with pressure type lubricating fittings, extend lubricating fittings to accessible locations.

5. Drive Assembly: Electric motor driven V-belt drive assembly, with belts having a service factor which is 50% greater than the rated HP of the motor. Provide cast iron or steel adjustable pulleys, with keyed hub, securely attached to shaft. Mount driving motor on rails for ease in adjustment of belt tension.

6. Motors shall be heavy duty ball bearing open drip proof motors (except explosion proof where necessary). Motors shall be high efficiency with minimum nominal efficiencies in accordance with ASHRAE standard 90.1-2004. Efficiencies shall be demonstrated in accordance with NEMA standard MGI.

7. Guards: Provide belt drive with an expanded metal or sheet metal guard, of substantial construction to comply with all safety codes. Floor supported guards shall have the legs securely fastened to the floor, as directed and approved. Guards supported from the fan shall be securely bolted thereto. Guards shall be easily removable for access to belts and pulleys, and shall be provided with covered test openings, to permit RPM readings of fan and motor, without removal of belt guard.

PART 3 EXECUTION

3.1 INSTALLATION

A. General:

1. Install fans and accessories in complete accordance with manufacturer's printed installation instructions and the requirements of the Contract Documents.

2. Provide sheaves required for final air balance.

B. Roof Mounted Exhaust Fans:

1. Secure roof exhausters with cadmium plated steel or stainless steel lag screws to roof curb.

2. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.

C. Hung Cabinet Fans:

1. Install fans with resilient mountings.

2. Install flexible connections specified in Section 23 3300 between fan and ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.

D. Centrifugal In-line and Duct Fans:

1. Install fans with vibration isolation.

2. Install flexible connections between fan and ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.

3. Provide inlet air screens on fans not indicated to have an inlet duct connection. If fan has inlet bearing, mount screen inside bearing.

END OF SECTION

SECTION 23 3700 - AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Diffusers.

B. Registers/grilles.

C. Louvers.

D. Dampers.

E. Stationary Roof Vents.

1.2 RELATED REQUIREMENTS

A. Section 23 3100 - Ductwork.

B. Section 23 3300 - Ductwork Accessories.

1.3 REFERENCE STANDARDS

A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; Air Movement and Control Association International, Inc.; 2007.

B. ASHRAE Std 70 - Method of Testing for Rating the Performance of Air Outlets and Inlets; American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.; 2006.

C. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association; 2005.

1.4 SUBMITTALS

A. Product Data: Catalog sheets, diagrams, standard schematic drawings, and installation instructions for each manufactured product.

B. Color Selection: Submit manufacturer's color selection chart to Architect for louver color selection.

C. Schedule of Outlets and Inlets: Indicate type keyed to contract drawings, application, size, airflow, pressure drop, and noise level.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Unless otherwise shown or specified comply with the applicable requirements of the following:

    a. SMACNA: Gages of material, fabrication, sealing, and installation shall be in accordance with the SMACNA Manuals.

        1) HVAC Duct Construction Standards.

        2) Round Industrial Duct Construction Standard.

        3) Rectangular Industrial Duct Construction Standard.

    b. NFPA: Standards No. 90A, 90B, 91, 96, and 101.

    c. UL: Standards No. UL181, UL555, and UL555S.

    d. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.

    e. Test and rate louver performance in accordance with AMCA 500-L.

1.6 MAINTENANCE

A. Special Tools:

1. One bar deflection key for every five supply grilles or diffusers.

2. Two keys or socket wrenches for each type of damper adjustment screw or device on manual damper regulators.

3. One tool for each type and size security fastener.

PART 2 PRODUCTS (SEE MECHANICAL SCHEDULES FOR PRODUCTS)

2.1 SUPPLY AIR OUTLETS:

A. Manufacturers:

1. Price Industries.

2. Titus.

3. Krueger.

4. Approved Equal.

B. Type 'S1':

1. Model: Price SCD.

2. Description: Steel - Square ceiling diffuser with round neck and 4 cones. Back cone shall be one piece seamless construction and corporate a round inlet collar of sufficient length for connecting, rigid or flexible duct.

3. Diffuser shall integrate with all duct sizes shown on plans without affecting face size or appearance.

4. Border: Provide appropriate border to accommodate mounting per ceiling type.

5. Finish: B12 White powder coat.

C. Type 'S2':

1. Model: Price 720 Series.(Stainless Steel; match duct material)

2. Description: Stainless Steel - Double deflection type louvered grille with two sets of fully adjustable deflection blades spaced at 3/4" on center. Include damper adjustable from grille face on.

3. Border: Standard Type 'F'.

4. Grille Finish: B12 White powder coat.

5. Damper Finish: Stainless Steel.

2.2 RETURN AIR INLETS:

A. Manufacturers:

1. Price Industries.

2. Titus.

3. Krueger.

4. Approved Equal.

B. Type 'R1':

1. Model: Price Series 80.

2. Description: Aluminum 1/2"x1/2"x1" grids (egg crate core) with extruded aluminum border. Sized per schedule on drawings.

3. Border: Type TSF for lay-in installation, Type SF for surface mount. Panel mounting shall not be allowed.

4. Finish: B12 white powder coat.

5. Provide with factory fabricated square to round adapter for connection to ductwork.

2.3 EXHAUST AIR INLETS:

A. Manufacturers:

1. Price Industries.

2. Titus.

3. Krueger.

4. Approved Equal.

B. Type 'E1'

1. Model: Price 730

2. Description: Stainless steel return grille with fixed 45 degree blades spaced at 3/4" on center. Blades shall run parallel to long or short dimension of grille as indicated on drawings.

3. Border: Standard flat border with counter-sunk screw mounting suitable to flush mount.

4. Finish: Stainless Steel

2.4 LOUVERS

A. Manufacturers:

1. Greenheck.

2. Louvers and Dampers/Mestek Inc..

3. Ruskin.

4. Approved Equal.

B. Type: Stationary type louver with welded construction and drainable blades mounted in a 4 inch louver frame. Each stationary blade shall incorporate an integral downspout so water drains to blade end, then down the downspouts and out at the louver sill.

C. Blades: Position blades at 35 degree angle at 4 inch on centers.

D. Material: 6063T5 Extruded aluminum 0.081 inch nominal thickness.

E. Bird Screen: 3/4 inch x 3/4 inch framed, removable, rear-mounted aluminum bird screen. Provide insect screen in lieu of bird screen where indicated on drawings.

F. Finish: Louver shall be supplied with a baked enamel finish, color to be selected by Architect.

2.5 DAMPERS

A. Manufacturers:

1. Damper shall be of same Manufacturer as Louver.

B. Damper shall be same size as corresponding louver and be suitable for mounting directly to the louver or a flanged wall sleeve.

C. Type: Insulated airfoil opposed blade low leakage control damper. Maximum leakage rate 6 cfm/sq ft at 4 in wg.

D. Frame: 5 inch x 1 inch hat channel with reinforced corners and welded joints.

E. Blades: Airfoil shaped, double skin construction equivalent to 14 gauge with integral 1/2 inch polystyrene. Mounted on 1/2 inch diameter plated steel axles with synthetic sleeve type bearings.

F. Linkage: Side linkage out of airstream concealed in frame. Weld actuator bracket to frame.

G. Seals: Extruded silicone rubber blade seals. Flexible metal compression type jamb seals.

H. Actuator:

1. Positive positioning, 120 volt actuator with spring return, furnished and sized for each louver by damper manufacturer.

2. Actuator shall fail closed upon loss of electric power.

2.6 STATIONARY ROOF VENTS

A. Manufacturers:

1. PennBarry; Model Airette.

2. Greenheck.

3. Approved Equal.

B. Fabricate air inlet or exhaust hoods in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

C. Fabricate of heavy gauge aluminum. Hood, throat, and curb cap shall be 14-gauge, and all internal bracing shall consist of 1.25"x1.25"x0.125" steel or aluminum angles. Removable hood and an aluminum 1/2" bird screen mounted across the intake/discharge area of the hood. Hoods and throat joints shall be seam welded and caulked. Internal bracing shall be welded.

D. Roof shall be "Cross-Braked" for water run off.

E. Mount unit on minimum 14 inch high insulated roof curb.

PART 3 EXECUTION

3.1 INSTALLATION

A. Unless otherwise specified, install the Work of this Section in accordance with manufacturer's printed installation instructions and the appropriate SMACNA Manual.

B. Coordination: Coordinate location of outlets and inlets with other trades. Make necessary minor adjustments in position to conform with architectural features, symmetry, sprinkler/smoke heads, and lighting arrangement.

1. Locate outlets and inlets to conform to reflected ceiling plans.

2. Arrange and locate duct taps to accomodate proper placement of outlets and inlets.

END OF SECTION

SECTION 23 5100 - BREECHINGS, CHIMNEYS, AND STACKS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Manufactured double wall chimneys for fuel fired equipment.

1.2 RELATED REQUIREMENTS

1.3 REFERENCE STANDARDS

A. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2009a.

B. ASTM A 666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2003.

C. ASTM A 1011/A 1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy, High-Strength Low-Alloy With Improved Formability, and Ultra-High Strength; 2009b.

D. NFPA 54 - National Fuel Gas Code; National Fire Protection Association; 2009.

E. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances; National Fire Protection Association; 2010.

F. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association; 2005.

G. UL 103 - Factory-Built Chimneys for Residential Type and Building Heating Appliances; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

H. UL 441 - Standard for Gas Vents; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

I. UL 641 - Type L Low Temperature Venting Systems; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

J. UL 959 - Medium Heat Appliance Factory Built Chimneys; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.4 DEFINITIONS

A. Breeching: Vent Connector.

B. Chimney: Primarily vertical shaft enclosing at least one vent for conducting flue gases outdoors.

C. Smoke Pipe: Round, single wall vent connector.

D. Vent: That portion of a venting system designed to convey flue gases directly outdoors from a vent connector or from an appliance when a vent connector is not used.

E. Vent Connector: That part of a venting system that conducts the flue gases from the flue collar of an appliance to a chimney or vent, and may include a draft control device.

1.5 DESIGN REQUIREMENTS

A. Factory built vents and chimneys used for venting natural draft appliances shall comply with NFPA 211 and be UL listed and labeled.

1.6 SUBMITTALS

A. Product Data: Provide data indicating factory built chimneys, including dimensional details of components and flue caps, dimensions and weights, electrical characteristics and connection requirements.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum five years of documented experience.

1.8 REGULATORY REQUIREMENTS

A. Conform to applicable code for installation of natural gas burning appliances and equipment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. American Metal Products/Commercial Products Group

B. Metal-Fab, Inc

C. Selkirk, Inc; Model PS

D. Approved Equal

2.2 DOUBLE WALL METAL STACKS

A. Provide double wall metal stacks, tested to UL 103 and UL listed, for use with building heating equipment, in compliance with NFPA 211.

B. Fabricate with 1 inch minimum air space between walls. Construct inner jacket of 20 gage ASTM A 666, Type 304 stainless steel. Construct outer jacket of aluminum coated steel 24 gage for sizes 10 inches to 24 inches and 20 gage for sizes 28 inches to 48 inches.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NFPA 54.

C. Provide all modular straight sections, fittings, supports, guides, expansion joints, guy sections, guy tensioners, roof thimbles, roof flashings, storm collars and stack cap terminations as required to provide a complete system per the manufacturer's installation instructions.

D. The vertical stack termination shall be no less than two feet above any portion of the building within ten feet of the stack penetration (see NFPA-211).

E. Assemble and install stack sections in accordance with NFPA 82, industry practices, and in compliance with UL listing. Join sections with acid-resistant joint cement. Connect base section to foundation using anchor lugs.

F. Level and plumb chimney and stacks.

G. Clean breechings, chimneys, and stacks during installation, removing dust and debris.

END OF SECTION

SECTION 23 5216 - CONDENSING BOILERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Manufactured units.

B. Boiler construction.

C. Boiler trim.

D. Fuel burning system.

E. Factory installed controls.

1.2 REFERENCE STANDARDS

A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); Current Edition.

B. ANSI Z21.13 - American National Standard for Gas-Fired Low Pressure Steam and Hot Water Boilers; 2017, with Errata (2018).

C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2023.

E. NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI); Current Edition.

F. NFPA 54 - National Fuel Gas Code; 2018.

G. SCAQMD 1146.1 - Emissions of Oxides of Nitrogen from Small Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters; 1990, with Amendment (2018).

1.3 SUBMITTALS

A. Product Data: Provide data indicating general assembly, components, controls, safety controls, and wiring diagrams with electrical characteristics and connection requirements, and service connections.

B. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, cleaning procedures, replacement parts list, and maintenance and repair data.

C. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect boilers from damage by leaving factory inspection openings and shipping packaging in place until final installation.

1.5 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide a five year warranty to include coverage for heat exchanger.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Condensing Hot Water Boiler for Indoor Applications:

1. Weil-McLain: www.weilmclain.com.

2. Approved Equal.

2.2 MANUFACTURED UNITS

A. Factory assembled, factory fire-tested, self-contained, readily transported unit ready for automatic operation except for connection of water, fuel, electrical, and vent services.

B. Unit: Metal membrane wall, water or fire tube, condensing boiler on integral structural steel frame base with integral fuel burning system, firing controls, boiler trim, insulation, and removable jacket, suitable for indoor application.

2.3 BOILER CONSTRUCTION

A. Comply with the minimum requirements of ASME BPVC-IV and ANSI Z21.13 for construction of boilers.

B. Assembly to bear the ASME "H" stamp and comply with the efficiency requirements of the latest edition of ASHRAE Std 90.1 I-P.

C. Required Directory Listings:

1. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); current edition at www.ahrinet.org.

2. NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI); current edition at www.nationalboard.org.

D. Heat Exchanger: Construct with materials that are impervious to corrosion where subject to contact with corrosive condensables.

E. Provide adequate tappings, observation ports, removable panels, and access doors for entry, cleaning, and inspection.

F. Insulate casing with insulation material, protected and covered by heavy-gauge metal jacket.

G. Factory apply boiler base and other components, that are subject to corrosion, with durable, acrylic, powder coated, painted, or weather-proofed finish.

2.4 BOILER TRIM

A. ASME rated pressure relief valve.

B. Flow switch.

C. Electronic Low Water Cut-off: Complete with test light and manual reset button to automatically prevent firing operation whenever boiler water falls below safe level.

D. Temperature and pressure gauge.

E. Pressure Switches:

1. High gas pressure.

2. Low gas pressure.

3. Air pressure.

F. Manual reset high limit.

G. Boiler Pump (where required by boiler design):

1. Primary pump, factory supplied and sized for field installation to ensure minimum, continuous circulation through boiler.

2. Where pump is not provided by boiler manufacturer, provide pump in accordance with boiler manufacturer's recommendations.

3. Pump time delay.

2.5 FUEL BURNING SYSTEM

A. Provide forced draft automatic burner or pulse combustion, integral to boiler, designed to burn propane, and maintain fuel-air ratios automatically.

1. Blower Design: Statically and dynamically balanced to supply combustion air; direct connected to motor.

2. Forced Draft Design: Mixes combustion air and gas to achieve 95 percent combustion efficiency.

3. Pulse Combustion Design: Self-aspirating, not requiring blower for combustion.

4. Combustion Air Filter: Protects fuel burning system from debris.

B. Gas Train: Plug valve, safety gas valve, gas-air ratio control valve, and pressure regulator controls air and gas mixture.

C. Emission of Oxides of Nitrogen Requirements: Comply with SCAQMD 1146.1 for natural gas fired system, as applicable.

D. Intakes: Combustion air intake capable of accepting free mechanical room air or direct outside air through a sealed intake pipe.

2.6 FACTORY INSTALLED CONTROLS

A. Option for internal or external (0-10) VDC control.

B. Temperature Controls:

1. Automatic reset type to control fuel burning system on-off and firing rate to maintain temperature.

2. Manual reset type to control fuel burning system to prevent boiler water temperature from exceeding safe system water temperature.

3. Low-fire start time delay relay.

C. Electronic PI setpoint/modulation control system.

D. Microprocessor-based, fuel/air mixing controls.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install boiler and provide connection of natural gas service in accordance with requirements of NFPA 54 and applicable codes.

C. Pipe relief valves to nearest floor drain.

D. Pipe cooled condensate produced by the combustion process from the boiler condensate connection and/or flue stack with suitable piping material to neutralizer prior to discharging into nearest floor drain.

3.2 CLOSEOUT ACTIVITIES

A. Demonstrate proper operation of equipment to Owner's designated representative.

B. Demonstration: Demonstrate operation of system to Owner's personnel.

1. Use operation and maintenance data as reference during demonstration.

2. Briefly describe function, operation, and maintenance of each component.

C. Training: Train Owner's personnel on operation and maintenance of system.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

2. Provide minimum of two hours of training.

END OF SECTION

SECTION 23 5400 - FURNACES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Forced air furnaces.

B. Thermostats.

1.2 RELATED REQUIREMENTS

1.3 REFERENCE STANDARDS

A. ANSI Z21.47 - American National Standard for Gas-Fired Central Furnaces; 2012.

B. ASHRAE Std 103 - Methods of Testing for Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers; 2017, with Errata (2019).

C. NFPA 54 - National Fuel Gas Code; 2018.

D. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.

E. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2015.

F. NFPA 211 - Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances; 2019.

1.4 SUBMITTALS

A. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.

B. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.

C. Manufacturer's Instructions: Indicate rigging, assembly, and installation instructions.

D. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.5 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide three year manufacturers warranty for solid state ignition modules.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Trane Inc, a subsidiary of Ingersoll Rand: www.trane.com.

B. Comfort Aire

C. Rheem

D. Armstrong

E. Approved Equal.

2.2 GAS FIRED FURNACES

A. Annual Fuel Utilization Efficiency (AFUE): 0.95 ("condensing") in accordance with ASHRAE Std 103.

B. Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heating element, controls, air filter, cooling coil, and accessories; wired for single power connection with control transformer.

1. Safety certified by CSA in accordance with ANSI Z21.47.

2. Venting System: Direct.

3. Combustion: Sealed.

4. Air Flow Configuration: Upflow.

5. Heating: Propane gas fired.

6. Accessories:

a. Concentric wall/roof termination kit.

C. Cabinet: Steel with baked enamel finish, easily removed and secured access doors with safety interlock switches, glass fiber insulation with reflective liner.

D. Gas Burner:

1. Atmospheric type with adjustable combustion air supply.

2. Gas valve, two stage provides 100 percent safety gas shut-off; 24 volt combining pressure regulation, safety pilot, manual set (On-Off), pilot filtration, automatic electric valve.

3. Electronic pilot ignition, with electric spark igniter.

4. Combustion air damper with synchronous spring return damper motor.

5. Non-corrosive combustion air blower with permanently lubricated motor.

E. Gas Burner Safety Controls:

1. Thermocouple sensor: Prevents opening of gas valve until pilot flame is proven and stops gas flow on ignition failure.

2. Flame rollout switch: Installed on burner box and prevents operation.

3. Vent safety shutoff sensor: Temperature sensor installed on draft hood and prevents operation, manual reset.

4. Limit Control: Fixed stop at maximum permissible setting, de-energizes burner on excessive bonnet temperature, automatic resets.

F. Supply Fan: Centrifugal type rubber mounted with direct drive with adjustable variable pitch motor pulley.

G. Motor:

1. multiple speed, permanently lubricated, hinge mounted.

H. Air Filters: 1 inch thick urethane, washable type arranged for easy replacement.

I. Operating Controls:

1. Room Thermostat: Cycles burner to maintain room temperature setting.

2. Supply Fan Control: Energize from bonnet temperature independent of burner controls, with adjustable timed off delay and fixed timed on delay, with manual switch for continuous fan operation.

2.3 THERMOSTATS

A. Room Thermostat: Low voltage, electric solid state microcomputer based room thermostat with remote sensor:

1. Preferential rate control to minimize overshoot and deviation from setpoint.

2. Programming based on weekdays, Saturday and Sunday.

3. Thermostat Display:

a. Actual room temperature.

b. System Mode Indication: Heating, cooling, fan auto, off, and on, auto or on, off.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions and requirements of authorities having jurisdiction.

B. Install in accordance with NFPA 90A.

C. Install gas fired furnaces in accordance with NFPA 54.

D. Provide vent connections in accordance with NFPA 211.

END OF SECTION

SECTION 23 5533 - UNIT HEATERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electric Unit heaters.

B. Room thermostats.

1.2 SUBMITTALS

A. Product Data: Provide manufacturer's literature and data indicating rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.

B. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listing.

C. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner s name and registered with manufacturer.

1.3 REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.4 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide five year manufacturers warranty for heat exchangers.

PART 2 PRODUCTS

2.1 ELECTRIC UNIT HEATERS

A. Manufacturers:

1. Trane Inc: www.trane.com.

2. Marley Engineered Products: www.marleymep.com.

3. Modine: www.modinehvac.com.

4. Ruffneck: www.thermon.com

5. Approved Equal.

B. Assembly: UL listed and labelled assembly with terminal box and cover, and built-in controls.

C. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection. Provide integral circuit breaker for overcurrent protection.

D. Cabinet: 0.0478 inch steel with easily removed front panel with integral air outlet and inlet grilles.

E. Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.

F. Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard.

G. Motor: Permanently lubricated, sleeve bearings for horizontal models, ball bearings for vertical models.

H. Control: Separate fan speed switch and thermostat heat selector switch, factory wired, with switches built-in behind cover. Provide thermal overload.

I. Electrical Characteristics:

    1. Disconnect Switch: Factory mount disconnect switch.

2.2 EXPLOSION PROOF ELECTRIC UNIT HEATERS

A. Manufacturers:

    1. Trane Inc: www.trane.com.

    2. Marley Engineered Products: www.marleymep.com.

    3. Modine: www.modinehvac.com.

    4. Ruffneck: www.thermon.com

    5. Approved Equal.

B. Assembly: UL listed for Class 1 Div. 1 and labelled assembly with terminal box and cover, and built-in controls.

C. Heat Exchanger: Double Wall, liquid filled with three low watt density immersion type copper sheathed elements hermetically sealed into the core made of steel with aluminium fins.

D. Cabinet fabricated of 14-gauge (1.9 mm thickness) cold rolled steel, with individually adjustable coated. A wire fan guard chrome-plated louvers, epoxy coated. A wire fan

guard chrome-platedwith less than 1/4” (6.4 mm) spacing conforms to NEMA requirements and shields all moving parts to meet OSHA requirements.

E. Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.

F. Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard.

G. Motor: Motors PSC, explosion proof, permanently lubricated, ball bearing type, 1725 rpm.

H. Control: Separate fan speed switch and explosion proof wall mounted thermostat heat selector switch, factory wired, with switches built-in behind cover. Provide thermal overload.

I. Electrical Characteristics:

1. Disconnect Switch: Factory mount explosion proof disconnect switch.

2.3 CORROSION RESISTANT/WASH DOWN UNIT HEATERS

A. Manufacturers:

1. Trane Inc: www.trane.com.
2. Marley Engineered Products: www.marleymep.com.
3. Modine: www.modinehvac.com.
4. Ruffneck: www.thermon.com
5. Approved Equal.

B. Assembly: UL listed and labelled assembly with terminal box and cover, and built-in controls.

C. Casing: 16-gauge 304 stainless steel with a 304 stainless steel outlet protective grille and angled outlet louvers. Inlet grille shall be chrome plated. Control enclosure shall be NEMA-4X nonmetallic provided with hinged and latched access door that opens from bottom.

D. Elements: Heavy duty elements manufactured from rugged finned tubular steel and chrome plated. Factory wired and sealed for washdown applications.

E. Motors: Totally enclosed permanently lubricated manufactured with corrosion resistant windings to resist moisture and corrosion, factory wired to NEMA 4X enclosure and UL Listed. Motor and fan blade factory installed within heaters casing on ruvver isolators.

F. Fan Blades: Manufactured from anodized aluminum and finished with epoxy coating.

G. Controls: Standard with 24-volt transformer and control circuit, fusing, pilot light, thermostat with stainless steel capillary sensor and three position switch (heat-off-fan)

factory installed and wired in the control enclosure compartment to the terminal block. Equipped with corrosion resistant auto reset thermal overloads sealed to prevent moisture to enclosure.

H. Electrical Characteristics:

1. Disconnect Switch: Factory mount disconnect switch.

2.4 ROOM THERMOSTATS

A. Room Thermostat: Factory supplied room thermostat with remote sensor:

1. Thermostat display:

a. Actual room temperature.

b. Setpoint temperature.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that space is ready for installation of units and openings are as indicated on shop drawings.

B. Verify that proper power supply is available.

3.2 INSTALLATION

A. Install in accordance with NFPA 90A.

B. Install unit heaters with vibration isolation or mount rigidly in accordance with manufacturer recommendations .

END OF SECTION

SECTION 23 6313 - AIR COOLED REFRIGERANT CONDENSERS

<<<< UPDATE NOTES

PART 1 GENERAL

2.1 SECTION INCLUDES

A. Manufactured units.

B. Casing.

C. Condenser coils.

D. Fan requirements.

E. Controls.

2.2 RELATED REQUIREMENTS

A. Section 23 2300 - Refrigerant Piping.

2.3 REFERENCE STANDARDS

A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2008, Including All Addenda.

B. ASHRAE Std 15 - Safety Standard for Refrigeration Systems and Designation and Classification of Refrigerants ; 2019, with Errata (2020).

C. ASHRAE Std 20 - Methods of Testing for Rating Remote Mechanical-Draft Air-Cooled Refrigerant Condensers; 1997 (R2006).

D. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

F. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

2.4 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide rated capacities, weights, accessories, electrical requirements, and wiring diagrams.

C. Operation and Maintenance Data: Include start-up instructions, maintenance instructions, parts lists, controls, and accessories.

D. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

PART 2 PRODUCTS

3.1 MANUFACTURERS

A. Armstong:

B. York:

C. Comfort Aire

D. Approved Equal.

3.2 MANUFACTURED UNITS

A. Provide packaged, factory assembled, pre-wired unit, suitable for outdoor use consisting of casing, condensing coil and fans, integral sub-cooling coil liquid accumulator.

B. Construction and Ratings: In accordance with AHRI 210/240 and UL 207. Testing shall be in accordance with ASHRAE Std 20.

C. Performance Ratings: Energy Efficient Rating (EER)/Coefficient of Performance (COP) not less than prescribed by ASHRAE Std 90.1 I-P, in combination with compressor units.

3.3 CASING

A. House components in welded steel frame with steel panels with weather resistant, baked enamel finish.

B. Mount starters, disconnects, and controls in weatherproof panel provided with full opening access doors. Provide mechanical interlock to disconnect power when door is opened.

C. Provide removable access doors or panels with quick fasteners.

3.4 CONDENSER COILS

A. Coils: Aluminum fins mechanically bonded to seamless copper tubing. Provide sub-cooling circuits. Air test under water to 425 psig, and vacuum dehydrate. Seal with holding charge of nitrogen.

3.5 FAN REQUIREMENTS

A. Vertical discharge direct driven propeller type condenser fans with fan guard on discharge, equipped with roller or ball bearings with grease fittings extended to outside of casing.

B. Motors as indicated, in compliance with Section 23 0513.

3.6 CONTROLS

A. Provide factory wired and mounted control panel, NEMA 250, containing fan motor starters, fan cycling thermostats, compressor interlock, and control transformer.

B. Provide thermostat to cycle fan motors in response to outdoor ambient temperature.

PART 3 EXECUTION

4.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide connection to refrigeration piping system. See Section 23 2300. Comply with ASHRAE Std 15.

C. Provide cooling season start-up, winter season shut-down service, for first year of operation.

D. Shut-down system if initial start-up and testing takes place in winter and machines are to remain inoperative. Repeat start-up and testing operation at beginning of first cooling season.

END OF SECTION

SECTION 23 8124 - ROOM AIR CONDITIONERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Air cooled condensing units.

B. Indoor air handling (fan and coil) units for ductless systems.

1.2 REFERENCE STANDARDS

A. AHRI 210/240 - Standard for Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment; 2008, Including All Addenda.

B. AHRI 520 - Performance Rating of Positive Displacement Condensing Units; 2004.

C. ASHRAE Std 15 - Safety Standard for Refrigeration Systems and Designation and Classification of Refrigerants ; 2019, with Errata (2020).

D. ASHRAE Std 23 - Methods for Performance Testing Positive Displacement Refrigerant Compressors and Compressor Units; 2022.

E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.

F. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2015.

G. UL 207 - Standard for Refrigerant-Containing Components and Accessories, Nonelectrical; Current Edition, Including All Revisions.

1.3 SUBMITTALS

A. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.

B. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

C. Warranty: Submit manufacturers warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. LG.

B. Mitsubishi.

C. EMI.

D. Approved Equal.

2.2 SYSTEM DESIGN

A. Split-System Heating and Cooling Units: Self-contained, packaged, matched factory-engineered and assembled, pre-wired indoor and outdoor units; UL listed.

1. Cooling: Outdoor electric condensing unit with evaporator coil in ductless indoor unit.

2. Provide refrigerant lines internal to units and between indoor and outdoor units, factory cleaned, dried, pressurized and sealed, with insulated suction line.

B. Performance Requirements: See Drawings for additional requirements.

2.3 INDOOR UNITS FOR DUCTLESS SYSTEMS

A. Indoor Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, evaporator coil, and controls; wired for single power connection with control transformer.

B. Evaporator Coils: Copper tube aluminum fin assembly, galvanized or polymer drain pan sloped in all directions to drain, drain connection, refrigerant piping connections, restricted distributor or thermostatic expansion valve.

1. Construction and Ratings: In accordance with AHRI 210/240 and UL 207.

2. Manufacturer: System manufacturer.

2.4 OUTDOOR UNITS

A. Outdoor Units: Self-contained, packaged, pre-wired unit consisting of cabinet, with compressor and condenser.

1. Construction and Ratings: In accordance with AHRI 210/240 with testing in accordance with ASHRAE Std 23 and UL 207.

B. Air Cooled Condenser: Aluminum fin and copper tube coil, AHRI 520 with direct drive axial propeller fan resiliently mounted, galvanized fan guard.

C. Accessories: Filter drier, high-pressure switch (manual reset), low pressure switch (automatic reset), service valves and gauge ports, thermometer well (in liquid line).

1. Provide thermostatic expansion valves.

D. Operating Controls:

1. Control by room thermostat to maintain room temperature setting.

2. Low Ambient Kit: Provide refrigerant pressure switch to cycle condenser fan on when condenser refrigerant pressure is above 285 psig and off when pressure drops below 140 psig for operation to 0 degrees F.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrates are ready for installation of units and openings are as indicated on shop drawings.

B. Verify that proper power supply is available and in correct location.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions and requirements of local authorities having jurisdiction.

B. Install in accordance with NFPA 90A and NFPA 90B.

C. Install refrigeration systems in accordance with ASHRAE Std 15.

END OF SECTION

SECTION 23 8200 - CONVECTION HEATING AND COOLING UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Hydronic or steam unit heaters.

1.2 RELATED REQUIREMENTS

A. Section 23 2113 - Hydronic Piping.

B. Section 23 2114 - Hydronic Specialties.

1.3 SUBMITTALS

A. Product Data: Provide typical catalog of information including arrangements.

B. Shop Drawings:

1. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.

C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

D. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.5 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.

B. Provide 5 year manufacturer's warranty for heat exchanger.

PART 2 PRODUCTS

2.1 HYDRONIC UNIT HEATERS

A. Manufacturers:

1. Modine Manufacturing Company: www.modineHVAC.com.
2. Sterling Hydronics, a Mestek Company: www.sterlingheat.com.
3. Trane, a brand of Ingersoll Rand: www.trane.com.
4. Approved Equal.

B. Coils: Seamless copper tubing, silver brazed to steel headers, and with evenly spaced aluminum fins mechanically bonded to tubing.

C. Perform factory run test under normal operating conditions, water, and steam flow rates.

D. Casing: Minimum 18 gauge, 0.0478 inch thick sheet steel casing with threaded pipe connections for hanger rods for horizontal models and minimum 18 gauge, 0.0478 inch thick sheet steel top and bottom plates for vertical projection models.

E. Finish: Factory applied baked enamel of color.

F. Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard; horizontal models with permanently lubricated sleeve bearings; vertical models with grease lubricated ball bearings.

G. Air Outlet: Adjustable pattern diffuser on vertical projection models and two- or four-way louvers on horizontal projection models.

H. Totally Enclosed Motors: Permanently lubricated sleeve bearings on horizontal models, grease lubricated ball bearings on vertical models.

I. Control: Local solid state disconnect switch with electropneumatic thermostat.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's recommendations.

B. Install equipment exposed to finished areas after walls and ceilings are finished and painted.

C. Do not damage equipment or finishes.

D. Unit Heaters:

1. Hang from building structure, with pipe hangers anchored to building, not from piping or electrical conduit.

2. Mount as high as possible to maintain greatest headroom unless otherwise indicated.

E. Units with Hydronic Coils:

1. Provide with shut-off valve on supply piping and tamper-proof, balancing valve with memory stop on return piping.

2. If not easily accessible, extend air vent to exterior surface of cabinet for ease of servicing.

3. Provide float operated automatic air vents with stop valve for cabinet unit heaters, fan coil units, and unit heaters.

END OF SECTION

SECTION 26 0501 - MINOR ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electrical demolition.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify field measurements and circuiting arrangements are as indicated.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition drawings are based on casual field observation and existing record documents.

D. Report discrepancies to Engineer before disturbing existing installation.

E. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings to be removed.

B. Coordinate utility service outages with utility company and the owner.

C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

D. Existing Electrical Service: Maintain existing system in service at all times (until ready to be demolished and switched over to new service). Minimize outage duration to max extent possible. Contractor to provide temporary power as required. Refer to Section 26 0510 Basic Electrical Requirements for additional temporary power information, as well as, Contract Drawings for Sequence of Construction and Removals. Coordinate final sequencing with all trades, owner, and engineer prior to proceeding with work.

1. Obtain permission from Owner at least 72 hours before partially or completely disabling system.

2. Make temporary connections to maintain service in areas adjacent to work area.

E. Existing Fire Alarm System: Maintain existing system in service at all times throughout project duration. Disable system only to make switchovers and connections. Minimize outage duration to max extent possible.

1. Notify Owner before partially or completely disabling system. Make notifications at least [72] hours in advance.

2. Notify local fire service at least [72] hours before partially or completely disabling system.

3. Make temporary connections to maintain service in areas adjacent to work area.

F. Existing Telephone / Network System: Maintain existing system in service at all times throughout project duration. Disable system only to make switchovers and connections. Minimize outage duration to max extent possible.

1. Notify Owner at least 72 hours before partially or completely disabling system.

2. Notify telephone utility company at least 72 hours before partially or completely disabling system.

3. Make temporary connections to maintain service in areas adjacent to work area.

G. Existing Security System: Maintain existing system in service at all times throughout project duration. Disable system only to make switchovers and connections. Minimize outage duration to max extent possible.

1. Obtain permission from Owner at least 72 hours before partially or completely disabling system.

2. Make temporary connections to maintain service in areas adjacent to work area.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:

1. PCB-containing electrical equipment, including transformers, capacitors, and switches.

2. PCB- and DEHP-containing lighting ballasts.

3. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned wiring to source of supply.

D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

F. Disconnect and remove abandoned panelboards and distribution equipment.

G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

I. Repair adjacent construction and finishes damaged during demolition and extension work.

J. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified. All requirements to be per NEC.

L. The owner shall have the right to maintain ownership of all material and equipment scheduled to be removed from the site throughout the project duration. Contractor to coordinate with the owner and all material/equipment that the owner wishes to maintain ownership of shall be moved to a location on the site as designated by the owner. All material the owner does not wish to maintain ownership of shall become the property of the contractor and the contractor assumes responsibility to remove from the site.

3.4 CLEANING AND REPAIR

A. Clean existing materials and equipment that remain or that are to be reused.

B. Panelboards: Clean exposed surfaces, panel interior, and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

C. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts as necessary.

END OF SECTION

SECTION 26 0510 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Provide all labor, items, articles, materials, operations, methods or equipment listed, mentioned, indicated or scheduled on the drawings and specified herein, and required to complete the electrical work. Contract drawings and specifications are complementary and must be so construed to determine the full scope of work.

B. Drawings:

1. Contract Drawings are, in part, diagrammatic and are intended to convey the scope of the work and indicate the general arrangement of the equipment. Follow these drawings in laying out the work. Consult all drawings to become familiar with all conditions affecting the work and to verify spaces in which the work will be installed.

2. Reasonable changes required by job conditions (including offsetting of conduits around beams, etc.) shall be made, after obtaining the Engineer's approval, at no additional cost to the Owner.

C. Definitions: The term "provide" shall have the same meaning as "furnish and install". All materials so implied either on the drawings or in these specifications shall be furnished and installed unless specifically noted otherwise.

D. Where Contract Drawings call out a classified area all equipment, devices, and wiring methods to be suitable for this area per NEC and NFPA requirements. Refer to Contract Drawings for classified area locations and specifications for additional information.

1.2 QUALITY ASSURANCE

A. All work specified in Division 26 shall be performed by approved workmen qualified by satisfactory experience in the particular work.

1.3 STANDARDS

A. The following standards shall govern and shall constitute minimum requirements as approved. If the requirements of this specification exceed those of the standards mentioned, this specification shall govern.

1. Local building codes.

2. Underwriters Laboratories Inc., (UL) approved or listed: All materials shall be UL approved or third party certified.

3. Local electric utility: Standards in effect on bidding date.

4. Local telephone utility: Standards in effect on bidding date for service entrance.

5. National Electrical Manufacturer's Association, NEMA: Equipment enclosures, mountings and connections.

6. America National Standards Institute, ANSI: Where mentioned herein.

7. American Institute of Electronic and Electrical Engineers, IEEE: Power equipment.

8. National Electrical Safety Code, NESC: Outdoor and overhead work for temporary service.

9. Occupational Safety and Health Act, OSHA: Requirements for safety and health of employees.

10. National Fire Prevention Association, NFPA:

    a. No. 70, National Electric Code, NEC.

    b. No. 101, Life Safety Code.

1.4 SUBMITTALS

A. Submittals: Obtain approval before procurement, fabrication, or delivery of items to the job site. Partial submittals will not be acceptable and will be returned without review. Submittals shall include the manufacturer's name, trade name, place of manufacture, catalog number or model, nameplate data, size, layout dimensions, capacity, project specification and paragraph reference, applicable federal, military, industry, and technical society publication references, and other information necessary to establish contract compliance of each item to be furnished. Furnish a minimum of three (3) copies of shop drawings for each device/piece of equipment specified or called for.

B. Shop Drawings: In addition to the requirements specified elsewhere, shop drawings shall meet the following requirements. Drawings shall be a minimum of 8.5 inches by 11 inches in size, except as specified otherwise. Drawings shall include complete ratings information, wiring diagrams, and installation details of equipment indicating proposed location, layout/arrangement, control panels, accessories, piping, ductwork, and other itmes that must be shown to assure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. If equipment is disapproved, revise drawings to show acceptable equipment and resubmit.

C. Manufacturer's Data: Submittals for each manufactured items shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performace and characteristic curves, and catalog cuts.

D. Publication Compliance: Where equipment or materials are specified to conform to industry and technical society publications or organizations such as American National

Standards Institute (ANSI), American Society for Testing and Materials (ASTM), and Underwriters Laboratories Inc. (UL), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears. In lieu of the label or listing, submit a certificate from an approved independent testing organization, adequately equipped and competent to perform such services, stating that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's publications.

E. Submittals required: Supply shop drawing submittal information on the equipment as noted in each individual section.

F. Submit temporary power plan to engineer for approval prior to electrical outages or power disruptions.

1.5 RECEIPTS FOR LOOSE EQUIPMENT

A. Provide one receipt for all equipment as follows, to be signed by the Owner and delivered to the Engineer prior to request for final payment:

1. Spare material and equipment where specified.

2. Equipment accessories where specified.

3. Keys for panelboards and all other key operated equipment.

4. Circuit breaker handle locks and equipment pad-locks where specified.

5. As built drawings.

6. O&M manuals, shop drawings, wiring diagrams, field start-up and testing reports, warranties, etc...

1.6 OPERATING INSTRUCTIONS

A. Provide approved shop drawings, wiring diagrams, instruction manuals, operating instructions, service manuals, and signed instruction receipts bound in common folder; submit to Engineer for approval and delivery to Owner prior to request for final acceptance and payment.

B. Provide instruction on the operation and maintenance of all equipment installed in this Contract for personnel designated by the Owner. A minimum of two personnel instruction periods (8 hours each) by qualified instructors shall be provided on normal operating procedures, minor adjustments and changes, preventive maintenance, and safety precautions. Obtain signed receipt that Owner's representative has been so instructed and can satisfactorily operate the equipment. These instruction periods are in addition to the training requirements specified in each individual equipment specification section.

1.7 AS-BUILT DRAWINGS

A. Electrical Contractor shall record locations of all conduit runs with number and size of conductors as they are installed. This shall be done for all systems (power, control, signaling, communication, emergency, lighting, fire alarm, etc...). Underground conduit plans shall include elevations and conduit and pull box locations shall be dimensioned. As-built drawings shall include all field and addendum changes.

B. All circuit numbers/positions shall be correctly recorded on the drawings as they were installed. In addition, all Panelboard Schedules shall be computer generated and attached to the inside cover of each field installed panelboard.

C. At completion of the job before final payment will be certified, the Electrical Contractor shall submit four prints to the Engineer who will in turn transmit three copies to the Owner.

1.8 PERMITS AND INSPECTIONS

A. Cost of fees shall be included in the bid as follows:

1. Construction permits.

2. Inspections and tests as described in this section.

B. Underwriters' Certificate: Prior to submittal of Request for Final Payment, an electrical inspection certificate shall be obtained and submitted for approval. List of approved 3rd party inspecting underwriters is listed below:

1. Commonwealth Code Inspection Services, Inc.

2. Electrical Underwriters of NY, LLC (845-569-1759)

3. The Inspector, LLC (800-487-0535)

4. Other Underwriters are not restricted, however credentials shall be provided for Engineer approval prior to Inspection.

C. Contractor shall coordinate all required utility electrical service inspections with the utility. All inspection costs are to be included within the bid.

1. Contractor shall coordinate with Central Hudson regarding the site electrical service.

2. Refer to Contract Drawings for additional information and contact info.

1.9 CODES, STANDARDS, AND LISTINGS

A. All wiring, conduit, and materials shown on the drawings and/or herein specified shall be in accordance with National Electrical Code (NEC), New York State Uniform Fire Prevention Building Code and Life Safety Code.

B. Wiring, conduit, and materials for all systems shall be provided in sizes and numbers sufficient to function as specified and in accordance with manufacturer's recommendations.

C. Any discrepancies shall be called to the attention of the Engineer before bids are taken. Bids shall be based on code and functional adequacy. Failure of the Contractor in this respect shall not relieve him of responsibility for a fully adequate installation at no increase in cost.

D. If requested by the Engineer, when equipment that is not specified is proposed, then provide a list of usages in New York State when the proposed equipment has been in operation for at least 3 years.

1.10 LIGHTNING PROTECTION SYSTEMS

A. If existing lightning protection systems (LPS) are required to be modifed, relocated, or temporarily removed at any time during the project duration the contractor is to provide all required services (equipment, hardware, testing, UL master label, etc...) to re-install system as was prior to the commencement of the project. To clarify, if an air terminal, down conductor, or any other piece of equipment associated with an existing lightning protection system is preventing the specified work from commencing then this Contract shall be responsible for removing such items and reinstallation upon the completion of construction. If LPS has a UL master label the contractor shall have the system re-certified upon the completion of reinstallation and a new master label furnished to the site/owner. Contractor to field verify and closely coordinate all requirements with the owner and engineer.

1.11 TEMPORARY POWER

A. Project site is to be operational at all times. Provide temporary power provisions as required to facilitate continued operation during electrical demolition and connections. Provide all necessary equipment, portable power stations, starters, generator, devices, cabling, etc. as required for an overall complete and operable temporary power system. Provide temporary power plan to engineer for approval prior to performing electrical disruptions in service. Refer to the electrical drawings for sequence of construction / removals and additional information. All requirements to be per NEC.

B. Contractor to coordinate with the owner and plant operators to determine which loads will require temporary power and must be maintained during the demolition and installation of electrical equipment as indicated on the Contract Drawings. Upon identifying which loads will be required to be maintained throughout construction the contractor is to provide a temporary trailer-mounted generator(s) (sized as required to start/run all required loads

identified as being maintained throughout the electrical removals/installations), temporary cabling, temporary power station (starters and overcurrent protection) as well as all ancillary devices/equipment for a complete and operable temporary power system. All requirements to be per NEC.

C. Contractor to work with a generator manufacturer such as Cummins (or approved equal) to provide a complete and operable temporary power solution.

D. Contractor to furnish temporary trailer-mounted diesel generator set(s) to provide emergency power to each site throughout the duration of the project as necessary/required. Temporary generator(s) to be on site configured/connected prior to demolishing and taking existing electrical equipment offline. In addition, the temporary generator(s) are to remain on the project site and configured/connected until the proposed electrical systems have been installed and a system startup performed.

E. In the event of a power outage (during construction), the Owner will respond to the outage and ensure temporary generator(s) are running. The Contractor will be notified of the outage by the Owner and he/she will have four hours to respond and coordinate refueling and respond to any issues/malfunctions with the temporary generator. If the temporary generator fails for any reason, the Contractor will have 24 hours from failure to either repair or replace the temporary generator(s).

F. Contractor is responsible for all fuel costs, maintenance costs, temporary cabling, transfer switch/mechanism equipment, temporary power stations (starters and overcurrent protection), etc. as required to ensure emergency power is provided in the event of a normal power loss. Temporary power provisions shall be in place throughout the duration of the project.

G. Contractor to coordinate final placement of temporary generator(s) on site with the Owner. Contractor to provide temporary cabling as required to connect temporary generator system into existing distribution system. Assume 200 linear feet of cabling is required to each temporary generator system for bidding purposes.

H. Coordinate the overall sequence of removals with the owner and engineer.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All equipment and/or materials shall be new and shall carry the label of Underwriter's Laboratories Inc., whenever UL requirements are applicable.

B. Materials of same general type, such as wiring devices and luminaries, shall be of the same make throughout the building so that appearance and operation are uniform.

C. "Equal materials" shall comply with Supplementary General Conditions.

D. Drawings and specifications are based on one manufacturer's equipment requirements. The costs of all revisions required to meet the requirements of a different manufacturer's

equipment (even though mentioned on the drawings or specified) furnished by the Contractor shall be borne by the Contractor.

PART 3 - EXECUTION

3.1 INFORMATION FOR OTHER DIVISIONS

A. Provide all information concerning the equipment or work of Division 26 required by other Divisions in ample time to prevent delay in building progress.

3.2 INSTALLATION

A. All new material required shall be provided as part of this contract.

B. Electrical Contractor shall include all work as shown and described on Site Drawings, including site electrical drawings.

3.3 OPENINGS AND CHASES

A. Contractor shall provide all boxed openings, chases, recesses, lintels, and bucks required for the admission of the work.

B. Do not cut walls or floors that are waterproofed or pierce any structural member without written permission from the Engineer.

3.4 MOUNTING HARDWARE/EQUIPMENT

A. All electrical equipment, control panels, instrument panels, power panels, motor control centers, transmitters, controllers, starters, or VFDs are to be installed by this contract. Contractor is responsible for providing all unistrut, hardware, brackets, supports, equipment pads, and equipment as necessary to mount all electrical equipment, control panels, instrument panels, power panels, motor control centers, transmitters, controllers, starters, and VFDs as indicated on the Contract Drawings. Close coordination with owner, engineer, and applicable trade contractor required.

3.5 ANCHORS

A. Provide anchor bolts, sleeves, washers, nuts, and templates for anchoring of equipment. Check locations as work progresses.

3.6 SLEEVES AND INSERTS

A. Provide sleeves and inserts ahead of the general construction work and maintain them in position.

B. The Contractor shall bear the cost of cutting and patching required to make corrections resulting from the omission or improper location of sleeves and/or inserts.

C. Make sleeves in floors and partitions of galvanized steel with lock seam joints.

D. Make sleeves of extra heavy cast iron pipe or rigid galvanized steel pipe in outside walls, foundations, and footings.

E. Conduit sleeves shall be two sizes larger than the conduit passing through it.

F. Terminate sleeves flush with walls, partitions, and ceilings. Terminate sleeves 1/4" above floors.

G. Fill space between sleeve and conduit in underground walls with oakum and caulk with lead on both sides of wall, or use "Link Seal".

H. Fill space between sleeve and conduit with fiberglass blanket insulation when sleeve does not occur in an underground wall. Seal with an approved fire seal caulk.

3.7 PAINTING AND PROTECTIVE COATING

A. Finished Areas: All equipment and fittings shall be factory pre-finished and installed in such a manner as to eliminate necessity for field painting. Paint as directed when rusted or otherwise damaged. Conduit or surface raceway where shown exposed on drawings will be painted by others.

B. Unfinished areas (except crawl spaces): Hanger rods, brackets, angle supports, straps, etc., shall be cadmium plated per ASTM 165, Type NS.

C. Outdoor Work: All ferrous equipment and fittings cadmium plated after fabrication (ASTM 165 Type NS); all screws, nuts, washers, etc., brass or stainless steel.

3.8 ROUGHING

A. Before roughing for equipment furnished by others, obtain approved roughing drawings and exact location for each piece of equipment. Do not "rough-in" services without approved drawings.

B. Obtain drawings or proper information giving final location of all motor and control connections.

C. Unless otherwise detailed or specified:

1. All services shall be concealed within walls, above ceilings, etc.

2. Work shall be exposed only where approved by the Engineer.

3. Notify Engineer if work cannot be concealed, as intended.

4. Conduit to be buried in concrete with approval of Engineer only and then a conduit plan must be submitted.

5. Wiremold is to be used only per drawings as indicated. Usage otherwise only by written consent of Engineer.

3.9 CLEAN-UP

A. Contractor shall at all times keep the project free from accumulation of waste material or rubbish caused by their operation. Shall be done on a daily basis as required or directed by Engineer.

B. When directed, just prior to final acceptance, clean all equipment under contract including, but not limited to the following:

1. Lighting fixtures, panelboards, control centers, receptacles and switch plates.

2. All equipment to be painted, removing all rust, etc., and leave ready for painting.

3. Building, by removing all debris, leftover conduits, wire insulation, cartons, etc., left as a result of this work.

3.10 SUPPORTS

A. After thorough investigation of Architectural, Structural and Shop Drawings related to work to determine how and where equipment, fixtures, conduit, panelboards, etc., are to be supported, mounted or suspended, provide:

1. Extra steel, bolts, inserts, pipe stands, brackets or any other items required for proper support.

2. Supporting accessories where required, whether or not shown on drawings.

END OF SECTION

SECTION 26 0513 - MEDIUM-VOLTAGE CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Medium voltage cable.

B. Cable accessories.

1.2 RELATED REQUIREMENTS

A. Section 26 0553 - Identification for Electrical Systems.

1.3 REFERENCE STANDARDS

A. IEEE 48 - IEEE Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV; 1996 (R2009).

B. NEMA WC 74 - 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy; 2012.

C. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

A. Product Data: Provide for cable, terminations, and accessories.

B. Samples: Submit two samples of each size cable, 24 inches in length.

1. Select each length to include complete set of manufacturer markings.

2. Attach tag indicating cable size and application information.

3. One sample to be sent to utility company for review and the second sample is to be sent to the engineer for review.

C. Test Reports: Indicate results of cable test in tabular form and in plots of current versus voltage for incremental voltage steps, and current versus time at 30 second intervals at maximum voltage.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include

instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Project Record Documents: Record actual sizes and locations of cables.

F. Certificate of Compliance: Indicate approval of installation by authority having jurisdiction and local utility.

G. Maintenance Data: Include instructions for testing and cleaning cable and accessories.

1.5 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.

C. Installer Qualifications: Authorized installer of specified manufacturer with service facilities within 100 miles of Project.

D. Products: Listed, classified, and labeled as suitable for the purpose intended.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

F. Primary cable utilized for the new electrical services as specified on the Contract Drawings to be closely coordinated with the Utility.

PART 2 PRODUCTS

2.1 MEDIUM-VOLTAGE CABLE

A. Manufacturers:

1. General Cable Technologies Corporation; Spec 6360: www.generalcable.com/.

B. Medium Voltage Cable: NEMA WC 74 ethylene propylene insulated cable.

1. Voltage: 15 kV, 100% grounded.

2. Conductor: Aluminum, compact Class B, stranded, with copper tape shield.

3. Construction: Single conductor wire

4. 133% 220 mils EPR insulation

5. Shield - 100% tape shield coverage with 25% overlap.

6. Jacket - Black sunlight resistant, MV-105

7. Temperature rating of 105 degree celsius (normal)

8. UL Listed

9. To be Spec 6360 as manufactured by General Cable or approved equal.

    a. Note, Contractor to submit proposed cable sample to utility for approval prior to releasing for order.

2.2 CABLE ACCESSORIES

A. Potheads: IEEE 48, Class 1 termination. Pothead with porcelain insulators, cable connector and aerial lug, sealed cable entrance and support, and insulating compound.

B. Cable Terminations: IEEE 48, Class 2 porcelain insulator cable terminator in kit form.

C. Cast Epoxy Cable Terminations: IEEE 48, Class 1 cast epoxy cable termination in kit form with stress cone, shield ground connection, wet porcelain rain shield for outdoor units, epoxy resin molding material, and accessories and molds required for proper application.

D. Modular Cable Terminations: IEEE 48, Class 1, molded-rubber cable termination in kit form with stress cone, ground clamp, non-tracking rubber skirts, load break connector, rubber cap, and aerial lug.

E. Tape Terminations: IEEE 48; Class 1, tape termination kit with semi- conductive tape, stress control tape, splicing tape, vinyl plastic tape, stress cone, mechanical ground straps, and cable preparation kit.

F. Fireproofing Tape:

    1. Arc Proof conductors installed within manholes, handholes, or common pull boxes as follows:

        a. Arc proof new feeders.

        b. Arc proof existing feeders that are spliced to new feeders.

        c. Arc proof each feeder as a unit with half-lapped layer of 55 mils thick arc proofing tape, random wrapped or laced with glass cloth tape or glass-fiber cord. For arc proofing tape less than 55 mils thick add layers to equivalent of 55 mils thick arc proofing tape.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that conduit, duct, trench, or manholes are ready to receive cable.

B. Verify that field measurements are as indicated.

C. Verify routing and termination locations of cable bank prior to rough-in.

D. Cable routing is shown in approximate locations unless dimensioned. Route as required to complete wiring system.

3.2 PREPARATION

A. Use swab to clean conduits before pulling cables.

B. Closely coordiante installation with local utiltiy. Provide utility required inspections as required.

3.3 INSTALLATION

A. Avoid abrasion and other damage to cables during installation.

B. Use suitable lubricants and pulling equipment.

C. Sustain cable pulling tensions and bending radii below recommended limits.

D. Ground cable shield at each termination and splice.

E. Install cables in manholes along wall providing longest route and provide service loop within each underground structure that cables are routed through.

F. Arrange cable in manholes and hand holes to avoid interference with duct entrances.

G. Fireproof cables in manholes using fireproofing tape in half-lapped wrapping. Extend fireproofing 1 inch into duct.

3.4 FIELD QUALITY CONTROL

A. Keep ends of cables sealed at all times, except when making splices or terminations. Use soldered seals for lead sheath cables. For other type cables use heat shrinkable plastic end caps with sealant as produced by Raychem Corp., or Thomas & Betts Corp., or other methods approved by cable manufacturer.

B. Inspect exposed cable sections for physical damage.

C. Inspect cable for proper connections as indicated.

D. Inspect shield grounding, cable supports, and terminations for proper installation.

E. Perform all inspections and tests listed in NETA ATS, Section 7.3.3 including but not limited to a high voltage after installation test. Perform all tests in the presence of the Owner's Representative.

1. Perform tests after cable has been installed complete with all splicing, bonding, etc., and prior to placing cable into service.

2. Provide minimum 1-week notice to owner/utility prior to performing tests.

3. Provide written report detailing testing results/findings and turn over to the owner/engineer for review.

4. Correct all deficiencies discovered as a result of testing.

3.5 PROTECTION

A. Protect installed cables from entrance of moisture.

END OF SECTION

SECTION 26 0515 - ELECTRICAL FIRESTOPPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Firestopping materials.

B. Firestopping of all penetrations, openings, and interruptions to fire rated assemblies, whether indicated on drawings or not, including but not limited to piping, tubing, and similar utilities passing through or penetrating fire rated walls and floor assemblies.

1.2 RELATED SECTIONS

A. Refer to "Code Compliance Drawings" for location of fire rated assemblies (coordinate with the engineer). At a minimum all corridor walls and all floors between stories have a 1-hour rating. Final requirements to be closely coordinated with the engineer.

1.3 REFERENCES

A. ASTM International:

1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

B. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.

C. Underwriters Laboratories Inc.:

1. UL 263 - Fire Tests of Building Construction and Materials.

2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

3. UL 1479 - Fire Tests of Through-Penetration Firestops.

4. UL - Fire Resistance Directory.

1.4 FIRE-STOP SYSTEM PERFORMANCE REQUIREMENTS

A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration fire-stop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.

1. Fire-resistance-rated walls including fire walls, fire partitions, fire barriers and smoke barriers.

2. Fire-resistance-rated horizontal assemblies including floors and ceiling membranes of roof/ceiling assemblies.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For each through-penetration fire-stop system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include fire-stop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated. Submit UL Standard detail for each penetration type proposed.

1.6 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs which provide the specified fire ratings when tested in accordance with methods indicated.

1. Listing in the current-year classification or certification books of UL will be considered as constituting an acceptable test report.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for 3 days after installation of materials.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Hilti.

B. Nelson Fire Stop Products.

C. Specified Technology.

D. 3M Fire Protection Products.

E. Approved equals meeting UL requirements.

2.2 MATERIALS

A. Sealant Firestopping:

1. Intumescent firestop sealant designed to expand when exposed to fire.
2. Paintable
3. Fire Resistance: Up to 4 hours
4. Curing Time: 14-21 days
5. Elongation: 5%
6. Density: 1.5 g/cm3
7. Product: FS-ONE Intumescent Firestop Sealant manufactured by Hilti USA.
8. Uses: Insulated and uninsulated metal pipes, with or without sleeve, jacketed cables, cable bundles, plastic pipes, sheet metal duct, and top of wall joints.

B. Silicone Sealant Firestopping:

1. Silicone based firestop sealant that provides maximum movement in fire-rated joint applications and pipe penetrations.
2. Not paintable
3. Fire Resistance: Up to 4 hours
4. Elongation: 25%
5. Product: CP 601S Elastomeric Firestop Sealant manufactured by Hilti USA.
6. Uses: Joints in walls, floor to floor or fire compartments.

C. Safing Insulation:

1. Mineral-wool type insulation.
2. Thickness: 1" to 1-1/2"
3. Density: 4 to 8 pcf
4. Product: THERMAFIBER Safing Insulation

D. Mechanical systems with fillers. Uses: cable trays, bus duct.

E. Sleeves:

1. Provide sleeves in accordance with Installation requirements section.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify openings are ready to receive sleeves and firestopping materials proposed.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration fire-stop systems to comply with fire-stop system manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration fire-stop systems.

2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration fire-stop systems. Remove loose particles remaining from cleaning operation.

3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration fire-stop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General

1. Install materials in manner described in UL Detail and in accordance with manufacturer's instructions, completely closing openings.

B. Installation

1. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.

2. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

3. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.

4. Fire Rated Surface:

    a. Seal opening at floor, wall, partition, and roof as follows:

        1) Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.

        2) Size sleeve allowing minimum of 1 inch void between sleeve and building element.

        3) Pack void with backing material.

        4) Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

    b. Where cable tray, conduit, wireway, and trough penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.

5. Non-Rated Surfaces:

    a. Seal opening through non-fire rated wall, floor, ceiling, and roof opening as follows:

        1) Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.

        2) Size sleeve allowing minimum of 1 inch void between sleeve and building element.

        3) Install type of firestopping material recommended by manufacturer.

    b. Install floor plates or ceiling plate where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.

    c. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.

    d. Interior partitions: Seal pipe penetrations at telecommunication rooms and data rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

C. Identification:

1. Identify through-penetration fire-stop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of edge of the fire-stop systems so that labels will be visible to anyone seeking to remove penetrating items or fire-stop systems. Use mechanical fasteners for metal labels. For plastic labels, use self-adhering type with adhesives capable of permanently bonding labels to surfaces on which labels are placed and, in combination with label material, will result in partial destruction of label if removal is attempted. Include the following information on labels:

    a. The words "Warning - Through-Penetration Fire-Stop System - Do Not Disturb. Notify Building Management of Any Damage."

    b. Date of installation.

    c. Through-penetration fire-stop system manufacturer's name.

3.4 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration fire-stop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration fire-stop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration fire-stop systems immediately and install new materials to produce systems complying with specified requirements.

END OF SECTION

SECTION 26 0519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Single conductor building wire.

B. Metal-clad cable.

C. Wiring connectors.

D. Electrical tape.

E. Heat shrink tubing.

F. Wire pulling lubricant.

G. Cable ties.

H. VFD Cables

1.2 RELATED REQUIREMENTS

A. Section 26 0501 - Minor Electrical Demolition: Disconnection, removal, and/or extension of existing electrical conductors and cables.

B. Section 26 0513 - Medium-Voltage Cables: Cables and terminations for systems 601 V through 35,000 V.

C. Section 26 0526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.

D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

E. Section 26 2100 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conductors.

1.3 REFERENCE STANDARDS

A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013.

B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011.

C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010 (Reapproved 2014).

D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2014).

E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2010.

F. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes; 2013.

G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

H. NECA 120 - Standard for Installing Armored Cable (AC) and Metal-Clad Cable (MC); 2012.

I. NEMA WC 70 - Nonshielded Power Cable 2000 V or Less for the Distribution of Electrical Energy; 2009.

J. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.

K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

L. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.

M. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.

N. UL 267 - Outline of Investigation for Wire-Pulling Compounds; Most Recent Edition, Including All Revisions.

O. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.

P. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.

Q. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.

R. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.

S. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.

2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.

3. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.

B. Field Quality Control Test Reports.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.8 FIELD CONDITIONS

A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Engineer and obtain direction before proceeding with work.

PART 2 - PRODUCTS

2.1 CONDUCTOR AND CABLE APPLICATIONS

A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.

B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

C. Nonmetallic-sheathed cable is not permitted.

D. Underground feeder and branch-circuit cable is not permitted.

E. Service entrance cable is not permitted.

F. Armored cable is not permitted.

G. Metal-clad cable is permitted only as follows:

1. Where not otherwise restricted, may be used:

a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.

b. Where concealed in hollow stud walls, above accessible ceilings, and under raised floors for branch circuits up to 20 A.

1) Exception: Provide single conductor building wire in raceway for circuit homerun from first outlet to panelboard.

2. In addition to other applicable restrictions, may not be used:

a. Where exposed to view.

b. Where exposed to damage.

c. For damp, wet, or corrosive locations.

2.2 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

A. Provide products that comply with requirements of NFPA 70.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Provide new conductors and cables manufactured not more than one year prior to installation.

D. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.

E. Comply with NEMA WC 70.

F. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.

G. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.

H. Conductors for Grounding and Bonding: Also comply with Section 26 0526.

I. Conductors and Cables Installed in Cable Tray: Listed and labeled as suitable for cable tray use.

J. Conductors and Cables Installed Where Exposed to Direct Rays of Sun: Listed and labeled as sunlight resistant.

K. Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted): Plenum rated, listed and labeled as suitable for use in return air plenums.

L. Conductor Material:

1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated on drawings are based on copper.

2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.

3. Tinned Copper Conductors: Comply with ASTM B33.

M. Minimum Conductor Size:

1. Branch Circuits: 12 AWG.

a. Exceptions:

1) 20 A, 120 V circuits longer than 75 feet: 10 AWG, for voltage drop.

2) 20 A, 120 V circuits longer than 150 feet: 8 AWG, for voltage drop.

3) 20 A, 277 V circuits longer than 150 feet: 10 AWG, for voltage drop.

2. Control Circuits: 14 AWG (unless specifically called out on the Contract Drawings).

N. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

O. Conductor Color Coding:

1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.

2. Color Coding Method: Integrally colored insulation.

    a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.

3. Color Code:

    a. 480Y/277 V, 3 Phase, 4 Wire System:

        1) Phase A: Brown.

        2) Phase B: Orange.

        3) Phase C: Yellow.

        4) Neutral/Grounded: Gray.

    b. 208Y/120 V, 3 Phase, 4 Wire System:

        1) Phase A: Black.

        2) Phase B: Red.

        3) Phase C: Blue.

        4) Neutral/Grounded: White.

    c. 240/120 V, 1 Phase, 3 Wire System:

        1) Phase A: Black.

        2) Phase B: Red.

        3) Neutral/Grounded: White.

    d. Equipment Ground, All Systems: Green.

    e. Isolated Ground, All Systems: Green with yellow stripe.

    f. Travelers for 3-Way and 4-Way Switching: Pink.

    g. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.

    h. For control circuits, comply with manufacturer's recommended color code.

2.3 SINGLE CONDUCTOR WIRE

A. Manufacturers:

1. Copper Wire:

a. Service Wire Co: www.servicewire.com/#sle

1) ServicePRO-X

b. Approved equal

B. Description: Single conductor insulated wire.

C. Conductor Stranding:

1. Feeders and Branch Circuits: Stranded.

2. Control Circuits: Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation:

1. Copper Wire: Type XHHW-2, Thermoset XLPE Insulation.

a. All insulation, whether installed outdoors, underground, building interior, damp environment, dry environment, hazardous spaces, etc. to be XHHW-2 (thermoset XLPE insulation).

2.4 METAL-CLAD CABLE

A. Manufacturers:

1. Encore Wire Corporation: www.encorewire.com/#sle.

2. Service Wire Co: www.servicewire.com/#sle.

3. Southwire Company: www.southwire.com/#sle.

4. Approved Equal

B. Description: NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.

C. Conductor Stranding:

1. All conductors to be Stranded.

D. Insulation Voltage Rating: 600 V.

E. Insulation: Type XHHW-2.

F. Provide oversized neutral conductors.

G. Grounding: Full-size integral equipment grounding conductor.

H. Armor: Steel, interlocked tape.

2.5 VFD CABLES

A. Utilize VFD rated shielded power cables for all VFD branch circuits (line side) and all motor feeder circuits (load side). Cable specifications are as follows:

1. 600V Rated
2. UL Ratings:
    a. TC-ER (Exposed Runs Rated)
    b. UL 44
    c. UL 1277
    d. NFPA 79 Flexible Motor Supply Cable
3. XHHW-2 conductor insulation (Thermoset XLPE)
4. Copper Tape Shield (5-mil with 50% overlap)
5. PVC jacket
6. Copper Phase Conductors
    a. 3 stranded copper conductors (XHHW-2 Thermoset XLPE)
7. Copper Ground Conductors
    a. 3 balanced copper grounds in direct contact with the shield
8. Sunlight resistant, oil resistant, and direct burial rated
9. 90 degree celcius wet/dry temperature rating
10. Class I & II; Division 2 Hazardous Locations
11. RoHS Compliant
12. FT-4, IEEE 1202 Flame Ratings
13. Overall Shield (100% coverage)

B. Contractor to provide/install termination kits and connectors as recommended by cable manufacturer. Follow manufacturers written recommendations for installation at all ends of cable.

C. Where cable is utilized with Rigid Conduit, contractor is to provide a ground strap on one end of the rigid conduit and ground to the cable ground system. Final requirements to be per manufacturer recommendations.

D. VFD Power Cables to be as manufactured by Service Wire Company, model ServiceDRIVE VFD Cable System or approved equal.

2.6 WIRING CONNECTORS

A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.

B. Connectors for Grounding and Bonding: Comply with Section 26 0526.

C. Wiring Connectors for Splices and Taps:

1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors.

2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.

D. Wiring Connectors for Terminations:

1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.

2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.

3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.

4. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.

5. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.

6. Conductors for Control Circuits: Use crimped terminals for all connections.

E. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.

F. Push-in Wire Connectors: Rated 600 V, 221 degrees F.

G. Mechanical Connectors: Provide bolted type or set-screw type.

H. Compression Connectors: Provide circumferential type or hex type crimp configuration.

I. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.

J. VFD Cables

1. Contractor to provide/install termination kits and connectors as recommended by cable manufacturer. Follow manufacturers written recommendations for installation at all ends of cable.

2.7 ACCESSORIES

A. Electrical Tape:

1. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.

a. Product: Scotch Super 33+ or approved equal.

2. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.

a. Product: Scotch 130C or approved equal.

B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.

C. Wire Pulling Lubricant:

1. Listed and labeled as complying with UL 267.

2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.

3. Suitable for use at installation temperature.

D. Cable Ties: Material and tensile strength rating suitable for application.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that work likely to damage wire and cable has been completed.

C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.

D. Verify that field measurements are as indicated.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.3 INSTALLATION

A. Circuiting Requirements:

1. Unless dimensioned, circuit routing indicated is diagrammatic.

2. When circuit destination is indicated without specific routing, determine exact routing required.

3. Arrange circuiting to minimize splices.

4. Include circuit lengths required to install connected devices within 10 ft of location indicated.

5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.

6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.

7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is permitted, under the following conditions:

a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.

b. Increase size of conductors as required to account for ampacity derating.

c. Size raceways, boxes, etc. to accommodate conductors.

d. Refer to contract drawings for additional information.

8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.

9. Provide oversized neutral/grounded conductors where indicated.

B. Install products in accordance with manufacturer's instructions.

C. Perform work in accordance with NECA 1 (general workmanship).

D. Install metal-clad cable (Type MC) in accordance with NECA 120.

E. Installation in Raceway:

1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.

2. Pull all conductors and cables together into raceway at same time.

3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.

4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.

F. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.

G. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.

1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.

H. Terminate cables using suitable fittings.

1. Metal-Clad Cable (Type MC):

a. Use listed fittings.

b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.

I. Variable-Frequency Drive Cable: Terminate shielding at both variable-frequency motor controller and associated motor using glands or termination kits recommended by manufacturer.

J. Install conductors with a minimum of 12 inches of slack at each outlet.

K. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.

L. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.

M. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.

N. Make wiring connections using specified wiring connectors.

1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.

2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.

3. Do not remove conductor strands to facilitate insertion into connector.

4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.

5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.

6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

O. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.

1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.

a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.

2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.

    a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.

    b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.

3. Wet Locations: Use heat shrink tubing.

P. Insulate ends of spare conductors using vinyl insulating electrical tape.

Q. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.

R. Identify conductors and cables in accordance with Section 26 0553.

S. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified.

T. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.4 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.

1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

C. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION

SECTION 26 0526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Grounding and bonding requirements.

B. Conductors for grounding and bonding.

C. Connectors for grounding and bonding.

D. Ground bars.

E. Ground rod electrodes.

1.2 RELATED REQUIREMENTS

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.

B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2007.

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. NFPA 780 - Standard for the Installation of Lightning Protection Systems; 2014.

G. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Verify exact locations of underground metal water service pipe entrances to building.

2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.

3. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.5 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.

B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

C. Field quality control test reports.

D. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING REQUIREMENTS

A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.

B. Do not use products for applications other than as permitted by NFPA 70 and product listing.

C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

E. Grounding System Resistance:

1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Engineer. Precipitation within the previous 48 hours does not constitute normally dry conditions.

2. Grounding Electrode System: Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.

3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points: Not greater than 0.5 ohms, when tested using "point-to-point" methods.

F. Grounding Electrode System:

1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.

a. Provide continuous grounding electrode conductors without splice or joint.

b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.

2. Metal Underground Water Pipe(s):

a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.

b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.

c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.

3. Metal In-Ground Support Structure:

   a. Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.

4. Gas Piping:

   a. Provide connection to underground metal (where present) gas service pipe(s) that are in direct contact with earth for at least 10 feet (3.0 m) at an accessible location not more than 5 feet (1.5m) from the point of entrance to the building. All requirements to be per applicable codes/regulations.

5. Concrete-Encased Electrode:

   a. Provide connection to concrete-encased electrode consisting of not less than 20 feet of either steel reinforcing bars or bare copper conductor not smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.

6. Ground Ring:

   a. Provide a ground ring encircling proposed buildings, structure, and equipment as indicated on the contract drawings. Ground ring shall consist of bare copper conductor not less than 2 AWG in direct contact with earth, installed at a depth of not less than 30 inches. Refer to the contract drawings for additional information.

   b. Where location is not indicated, locate ground ring conductor at least 24 inches outside building perimeter foundation.

   c. Provide connection from ground ring conductor to:

      1) Perimeter columns of metal building frame.

      2) Ground rod electrodes located as indicated.

      3) All Structures and equipment within 5 feet of ground ring.

7. Ground Rod Electrode(s):

   a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.

b. Space electrodes not less than 10 feet from each other and any other ground electrode.

c. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.

8. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.

9. Contractor to coordinate with the local utility company and provide required grounding for proposed utility pad-mounted transformer. Coordinate all efforts closely with the local utility.

G. Service-Supplied System Grounding:

1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.

2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.

H. Grounding for Separate Building or Structure Supplied by Feeder(s) or Branch Circuits:

1. Provide grounding electrode system for each separate building or structure.

2. Provide equipment grounding conductor routed with supply conductors.

3. For each disconnecting means, provide grounding electrode conductor to connect equipment ground bus to grounding electrode system.

4. Do not make any connections and remove any factory-installed jumpers between neutral (grounded) conductors and ground.

I. Separately Derived System Grounding:

1. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.

2. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.

3. Where common grounding electrode conductor ground riser is used for tap connections to multiple separately derived systems, provide bonding jumper to connect the metal building frame and metal water piping in the area served by the derived system to the common grounding electrode conductor.

4. Outdoor Source: Where the source of the separately derived system is located outside the building or structure supplied, provide connection to grounding electrode at source in accordance with NFPA 70.

5. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.

6. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.

J. Bonding and Equipment Grounding:

1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.

2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.

3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.

4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.

6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.

7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:

    a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.

    b. Metal gas piping.

c. Metal process piping.

8. Provide bonding for interior metal air ducts.

9. Provide bonding for metal building frame.

10. Provide bonding for metal siding / roofing not effectively bonded through attachment to metal building frame.

K. Communications Systems Grounding and Bonding:

1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.

2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.

a. Bonding Jumper Size: 6 AWG, unless otherwise indicated or required.

b. Raceway Size: 3/4 inch trade size unless otherwise indicated or required.

c. Ground Bar Size: 1/4 by 2 by 12 inches unless otherwise indicated or required.

d. Ground Bar Mounting Height: 18 inches above finished floor unless otherwise indicated.

L. Lightning Protection Systems:

1. Do not use grounding electrode dedicated for lightning protection system for component of building grounding electrode system provided under this section.

2. Provide bonding of building grounding electrode system provided under this section and lightning protection grounding electrode system in accordance with NFPA 70 and NFPA 780.

2.2 GROUNDING AND BONDING COMPONENTS

A. General Requirements:

1. Provide products listed, classified, and labeled as suitable for the purpose intended.

2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 0526:

1. Use insulated copper conductors unless otherwise indicated.

a. Exceptions:

1) Use bare copper conductors where installed underground in direct contact with earth.

2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:

1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.

2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.

3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.

D. Ground Bars:

1. Description: Copper rectangular ground bars with mounting brackets and insulators.

2. Size: As indicated.

3. Holes for Connections: As indicated or as required for connections to be made.

E. Ground Rod Electrodes:

1. Comply with NEMA GR 1.

2. Material: Copper-bonded (copper-clad) steel.

3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that work likely to damage grounding and bonding system components has been completed.

B. Verify that field measurements are as indicated.

C. Verify that conditions are satisfactory for installation prior to starting work.

D. Ground rod locations and other grounding componenet locations shown on the contract drawings are shown as diagramatical in nature. Exact locations to be determined in the field by the contractor to avoid interferances with existing conditions and proposed work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates.

1. Outdoor Installations: Unless otherwise indicated, install with top of rod 6 inches below finished grade.

2. Indoor Installations: Unless otherwise indicated, install with 4 inches of top of rod exposed.

D. Make grounding and bonding connections using specified connectors.

1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.

2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.

3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.

4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.

5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

E. Identify grounding and bonding system components in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.13.

C. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.

D. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.

E. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION

SECTION 26 0529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.2 RELATED REQUIREMENTS

A. Section 26 0534 - Conduit: Additional support and attachment requirements for conduits.

B. Section 26 0537 - Boxes: Additional support and attachment requirements for boxes.

C. Section 26 5100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.

D. Section 26 5600 - Exterior Lighting: Additional support and attachment requirements for exterior luminaires.

1.3 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.

C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2013.

D. MFMA-4 - Metal Framing Standards Publication; 2004.

E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.

2. Coordinate work to provide additional framing and materials required for installation.

3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.

4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.

5. Notify Engineer of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with specifications.

1.5 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for channel/strut framing systems, nonpenetrating rooftop supports, and post-installed concrete/masonry anchors.

B. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.6 QUALITY ASSURANCE

A. Maintain at project site one copy of each referenced document that prescribes execution requirements.

B. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:

1. Comply with the following. Where requirements differ, comply with most stringent.

    a. NFPA 70.

    b. Requirements of authorities having jurisdiction.

2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.

3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.

4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 25%. Include consideration for vibration, equipment operation, and shock loads where applicable.

5. Do not use products for applications other than as permitted by NFPA 70 and product listing.

6. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.

7. Steel Components: Use corrosion-resistant materials suitable for environment where installed.

    a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.

    b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated or specified on the Drawings. Supports shall match the materials of the equipment required to be supported.

    c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.

    d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.

    1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.

    2. Conduit Clamps: Bolted type unless otherwise indicated.

C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.

D. Metal Channel/Strut Framing Systems:

1. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.

2. Comply with MFMA-4.

E. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.

1. Minimum Size, Unless Otherwise Indicated or Required:

a. Equipment Supports: 1/2-inch diameter.

b. Busway Supports: 1/2-inch diameter.

c. Single Conduit up to 1-inch (27 mm) Trade Size: 1/4-inch diameter.

d. Single Conduit Larger than 1-inch (27 mm) Trade Size: 3/8-inch diameter.

e. Trapeze Support for Multiple Conduits: 3/8-inch diameter.

f. Outlet Boxes: 1/4-inch diameter.

g. Luminaires: 1/4-inch diameter.

F. Anchors and Fasteners:

1. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.

2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.

3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.

4. Hollow Masonry: Use toggle bolts.

5. Hollow Stud Walls: Use toggle bolts.

6. Steel: Use beam clamps, machine bolts, or welded threaded studs.

7. Sheet Metal: Use sheet metal screws.

8. Wood: Use wood screws.

9. Plastic and lead anchors are not permitted.

10. Preset Concrete Inserts: Continuous metal channel/strut and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.

a. Manufacturer: Same as manufacturer of metal channel/strut framing system.

b. Comply with MFMA-4.

c. Channel Material: Use galvanized steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install hangers and supports in accordance with NECA 1.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

D. Unless specifically indicated or approved by Engineer, do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Engineer, do not provide support from roof deck.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Equipment Support and Attachment:

1. Use metal, fabricated supports or supports assembled from metal channel/strut to support equipment as required.

2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.

3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.

4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 4 inch high concrete pad constructed in accordance with specifications.

5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H. Conduit Support and Attachment: See Section 26 0534 for additional requirements.

I. Box Support and Attachment: See Section 26 0537 for additional requirements.

J. Interior Luminaire Support and Attachment: See Section 26 5100 for additional requirements.

K. Exterior Luminaire Support and Attachment: See Section 26 5600 for additional requirements.

L. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.

M. Secure fasteners in accordance with manufacturer's recommended torque settings.

N. Remove temporary supports.

O. Identify independent electrical component support wires above accessible ceilings, where permitted, with color distinguishable from ceiling support wires in accordance with NFPA 70.

3.3 FIELD QUALITY CONTROL

A. Inspect support and attachment components for damage and defects.

B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

C. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 26 0534 - CONDUIT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Rigid galvanized steel metal conduit (RGS).

B. PVC-coated galvanized steel rigid metal conduit.

C. Flexible metal conduit (FMC).

D. Liquidtight flexible metal conduit (LFMC).

E. Galvanized steel electrical metallic tubing (EMT).

F. Rigid polyvinyl chloride (PVC) conduit.

1.2 RELATED REQUIREMENTS

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.

B. Section 26 0526 - Grounding and Bonding for Electrical Systems.

1. Includes additional requirements for fittings for grounding and bonding.

C. Section 26 0529 - Hangers and Supports for Electrical Systems.

D. Section 26 0537 - Boxes.

E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

F. Section 26 2100 - Low-Voltage Electrical Service Entrance: Additional requirements for electrical service conduits.

1.3 REFERENCE STANDARDS

A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2005.

B. ANSI C80.3 - American National Standard for Steel Electrical Metallic Tubing (EMT); 2005.

C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

D. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2013.

E. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2003.

F. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2012.

G. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit; 2005.

H. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2013.

I. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2015.

J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

K. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.

L. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.

M. UL 360 - Liquid-Tight Flexible Steel Conduit; Current Edition, Including All Revisions.

N. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

O. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.

P. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.

Q. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.

R. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.

S. UL 2419 - Outline of Investigation for Electrically Conductive Corrosion Resistant Compounds; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate minimum sizes of conduits with actual type and quantity of conductors to be installed, including adjustments for conductor sizes increased for voltage drop.

2. Coordinate arrangement of conduits with structural members, ductwork, piping, equipment, and other potential conflicts.

3. Verify exact conduit termination locations required for boxes, enclosures, and equipment.

4. Coordinate work to provide roof penetrations that preserve integrity of roofing system and do not void roof warranty.

5. Notify Engineer of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not begin installation of conductors and cables until installation of conduit between termination points is complete.

1.5 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

B. Shop Drawings:

1. Indicate proposed arrangement for conduits to be installed within structural concrete slabs, where permitted.

2. Include proposed locations of roof penetrations and proposed methods for sealing, where permitted.

C. Project Record Documents: Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 3/4" trade size and larger.

1.6 QUALITY ASSURANCE

A. Documents at Project Site: Maintain at project site one copy of manufacturer's instructions and shop drawings.

B. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 CONDUIT APPLICATIONS

A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70, manufacturer's instructions, and product listing.

B. Refer to the Raceway Schedule on the Electrical Drawings for permitted usage and restrictions.

C. Unless otherwise indicated and where not otherwise restricted, use conduit types indicated for specified applications. Where more than one listed application applies, comply with most restrictive requirements. Where conduit type for particular application is not specified, use galvanized steel rigid metal conduit.

D. Hazardous (Classified) Locations: Use PVC-coated galvanized steel rigid metal conduit.

E. Chemical rooms where corrosion protection is required. Use PVC-coated galvanized steel rigid metal conduit.

F. Connections to Luminaires: Use flexible metal conduit only where necessary/required (use of conduit type specified is not feasible). The length of flexible metal conduit is to be limited to the greatest extent possible.

1. Dry Locations: Use flexible metal conduit.

2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.

3. Maximum Length: 3.28 feet.

a. Contractor to minimize length of liquid-tight flexible metal conduit to greatest extent possible.

G. Flexible Connections to Vibrating Equipment:

1. Dry Locations: Use flexible metal conduit (FMC).

2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit (LFMC).

3. Maximum Length: 3.28 feet unless otherwise indicated.

a. Contractor to limit the length of flexible conduit connections to the greatest extent possible.

2.2 CONDUIT - GENERAL REQUIREMENTS

A. Comply with NFPA 70.

B. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling mandrel through them.

C. Electrical Service Conduits: See Section 26 2100 for additional requirements.

D. Fittings for Grounding and Bonding: See Section 26 0526 for additional requirements.

E. Provide conduit, fittings, supports, and accessories required for complete raceway system.

F. Provide products listed, classified, and labeled as suitable for purpose intended.

G. Minimum Conduit Size, 3/4-inch Unless Otherwise Indicated:

H. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.3 GALVANIZED STEEL RIGID METAL CONDUIT (RGS)

A. Description: NFPA 70, Type RGS galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

B. Fittings:

1. Fittings to be manufactured by American Fittings Corporation or approved equal.

2. Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B or UL 6.

3. Material: Use steel or malleable iron.

    a. Do not use die cast zinc fittings.

4. Connectors and Couplings: Use threaded type fittings only. Threadless fittings, including set screw and compression/gland types, are not permitted.

2.4 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT

A. Description: NFPA 70, Type RGS galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.

B. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil, 0.040 inch.

C. PVC-Coated Boxes and Fittings:

1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed, Plasti-Bond, American Fittings Corporation, or approved equal.

2. Nonhazardous Locations: Use boxes and fittings listed and labeled as complying with UL 514A, UL 514B, or UL 6.

3. Hazardous/Classified Locations: Use fittings listed and labeled as complying with UL 1203 for classification of installed location.

4. Material: Use steel or malleable iron.

5. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil, 0.040 inch.

D. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil. Utilize corrosion resistant product line as manufactured by power-strut defender.

E. PVC-Coated Galvanized Steel Rigid Metal Conduit and associated componenets/fittings to be by Plasti-Bond or approved equal.

2.5 FLEXIBLE METAL CONDUIT (FMC)

A. Description: NFPA 70, Type FMC standard-wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems.

B. Fittings:

1. Fittings to be manufactured by American Fittings Corporation or approved equal.

2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

3. Material: Use steel or malleable iron.

    a. Do not use die cast zinc fittings.

4. Contractor to minimize the use/lengths to greatest extent possible.

2.6 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

B. Fittings:

1. Fittings to be manufactured by American Fittings Corporation or approved equal.

2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

3. Material: Use steel or malleable iron.

    a. Do not use die cast zinc fittings.

4. Contractor to minimize the use/lengths to greatest extent possible.

2.7 GALVANIZED STEEL ELECTRICAL METALLIC TUBING (EMT)

A. Description: NFPA 70, Type EMT galvanized steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

B. Fittings:

1. Fittings to be manufactured by American Fittings Corporation or approved equal.

2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

3. Material: Use steel or malleable iron.

    a. Do not use die cast zinc fittings.

4. Connectors and Couplings: Use compression/gland or set-screw type.

    a. Do not use indenter type connectors and couplings.

2.8 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

A. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 80 unless otherwise indicated; rated for use with conductors rated 90 degrees C.

B. Fittings:

1. Manufacturer: Same as manufacturer of conduit to be connected, American Fittings Corporation, or approved equal.

2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.9 ACCESSORIES

A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil, 0.020 inch.

B. Conduit Joint Compound: Corrosion-resistant, electrically conductive compound listed as complying with UL 2419; suitable for use with conduit to be installed.

C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

D. Pull Strings: Use nylon or polyester tape with average breaking strength of not less than 1,250 lbf.

E. Foam Conduit Sealant:

1. Removable, two-part, closed-cell foam, specifically designed for sealing conduit openings against water, moisture, gases, and dust.

2. Suitable for use with conductors/cables and associated insulation/jackets to be installed.

3. Rated to hold minimum of 10 ft water head pressure.

F. Conduit Mechanical Seals:

1. Listed as complying with UL 514B.

2. Specifically designed for sealing conduit openings against water, moisture, gases, and dust.

3. Suitable for sealing around conductors/cables to be installed.

G. Sealing Compound for Hazardous/Classified Location Sealing Fittings: Listed for use with particular fittings to be installed.

H. Sealing Systems for Concrete Penetrations:

1. Sleeves: Provide water stop ring or cement coating that bonds to concrete to prevent water infiltration.

2. Rate for minimum of 40 psig; suitable for sealing around conduits to be installed.

I. Sealing Systems for Roof Penetrations: Premanufactured components and accessories as required to preserve integrity of roofing system and maintain roof warranty; suitable for conduits and roofing system to be installed; designed to accommodate existing penetrations where applicable.

J. Firestop Sleeves: Listed; provide as required to preserve fire resistance rating of building elements.

K. Duct Bank Spacers: Nonmetallic; designed for maintaining conduit/duct spacing for concrete encasement in open trench installation; suitable for conduit/duct arrangement to be installed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive conduits.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install conduit in accordance with NECA 1.

C. Install galvanized steel rigid metal conduit (RGS) in accordance with NECA 101.

D. Install PVC-coated galvanized steel rigid metal conduit using only tools approved by the manufacturer.

E. Rigid Polyvinyl Chloride (PVC) Conduit: Install in accordance with NECA 111.

F. Conduit Routing:

1. Unless dimensioned, conduit routing indicated is diagrammatic.

2. When conduit destination is indicated without specific routing, determine exact routing required.

3. Conceal all conduits within new walls and above ceilings where feasible/possible. Conduits within the control building and office spaces of the dewatering building to be concealed to greatest extent possible.

4. The majority of conduits throughout the site/buildings will be exposed.

5. Conduits installed underground or embedded in concrete may be routed in shortest possible manner unless otherwise indicated. Route other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.

6. Arrange conduit to maintain adequate headroom, clearances, and access.

7. Arrange conduit to provide no more than equivalent of four 90-degree bends between pull points.

8. Arrange conduit to provide no more than 150 feet between pull points.

9. Route conduits above water and drain piping where possible.

10. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.

11. Maintain minimum clearance of 6 inches between conduits and piping for other systems.

12. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:

    a. Heaters.

    b. Hot water piping.

    c. Flues.

13. Group parallel conduits in same area on common rack.

G. Conduit Support:

1. Secure and support conduits in accordance with NFPA 70 using suitable supports and methods approved by authorities having jurisdiction; see Section 26 0529.

2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.

4. Use conduit strap to support single surface-mounted conduit.

    a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.

5. Use metal channel/strut with accessory conduit clamps to support multiple parallel surface-mounted conduits.

6. Use conduit clamp to support single conduit from beam clamp or threaded rod.

7. Use trapeze hangers assembled from threaded rods and metal channel/strut with accessory conduit clamps to support multiple parallel suspended conduits.

8. Use nonpenetrating rooftop supports to support conduits routed across rooftops, where approved.

9. Use of wire for support of conduits is not permitted.

10. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with most stringent requirements.

H. Connections and Terminations:

1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.

2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.

3. Use suitable adapters where required to transition from one type of conduit to another.

4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.

5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.

6. Where spare conduits stub up through concrete floors and are not terminated in box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.

7. Provide insulating bushings, insulated throats, or listed metal fittings with smooth, rounded edges at conduit terminations to protect conductors.

8. Secure joints and connections to provide mechanical strength and electrical continuity.

I. Penetrations:

1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.

2. Make penetrations perpendicular to surfaces unless otherwise indicated.

3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.

4. Conceal bends for conduit risers emerging above ground.

5. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.

6. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty.

7. All conduit penetrations to be properly caulked, sealed, and patched to match adjacent finished surfaces. Coordinate final requirements with the owner.

8. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified.

J. Underground Installation:

1. Minimum Cover, Unless Otherwise Indicated or Required:

a. Underground, Exterior: 18 inches.

b. Under Slab on Grade: 12 inches to bottom of slab.

2. Provide underground warning tape in accordance with Section 26 0553 and the Contract Drawings along entire conduit length for all underground conduits.

3. Refer to Burial Details on Electrical Drawings for additional details.

K. Embedment Within Structural Concrete Slabs (only where approved by Structural Engineer):

1. Maximum Conduit Size: 1-inch trade size unless otherwise approved.

2. Secure conduits to prevent floating or movement during pouring of concrete.

L. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:

1. Where conduits cross structural joints intended for expansion, contraction, or deflection.

2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.

3. Where conduits are subject to earth movement by settlement or frost.

M. Conduit Sealing:

1. Use foam conduit sealant to prevent entry of moisture and gases. This includes, but is not limited to:

a. Where conduits enter building from outside.

b. Where service conduits enter building from underground distribution system.

c. Where conduits enter building from underground.

d. Where conduits may transport moisture to contact live parts.

2. Where conduits cross barriers between areas of potential substantial temperature differential, use foam conduit sealant at accessible point near penetration to prevent condensation. This includes, but is not limited to:

a. Where conduits pass from outdoors into conditioned interior spaces.

b. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.

N. Provide pull string in each empty conduit and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.

O. Provide grounding and bonding; see Section 26 0526.

P. Identify conduits; see Section 26 0553.

3.3 FIELD QUALITY CONTROL

A. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

B. Where coating of PVC-coated galvanized steel rigid metal conduit contains cuts or abrasions, Contractor is to repair in accordance with manufacturer's instructions.

C. Correct deficiencies and replace damaged or defective conduits.

3.4 CLEANING

A. Clean interior of conduits to remove moisture and foreign matter.

3.5 PROTECTION

A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION

SECTION 26 0537 - BOXES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.

B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.

C. Boxes for hazardous (classified) locations.

1. In addition reference section 26 2727

D. Underground boxes/enclosures.

1.2 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 0534 - Conduit:

1. Conduit bodies and other fittings.

2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.

D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

E. Section 26 2726 - Wiring Devices:

1. Wall plates.

2. Additional requirements for locating boxes for wiring devices.

1.3 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

D. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2012.

E. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013.

F. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports; 2013.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. SCTE 77 - Specification for Underground Enclosure Integrity; 2013.

I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

K. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.

L. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

M. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.

N. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.

4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.

5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.

6. Coordinate the work with other trades to preserve insulation integrity.

7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.

8. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for outlet and device boxes, junction and pull boxes, cabinets and enclosures, boxes for hazardous (classified) locations, and underground boxes/enclosures.

B. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

C. Project Record Documents: Record actual locations for outlet and device boxes, junction boxes, pull boxes, cabinets and enclosures, and underground boxes/enclosures.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 BOXES

A. General Requirements:

1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.

2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.

3. Provide products listed, classified, and labeled as suitable for the purpose intended.

4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

5. Provide grounding terminals within boxes where equipment grounding conductors terminate.

6. All new/modified boxes to be provided with covers and caps (all conduit knock-outs to be closed).

B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:

1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.

2. Use cast iron boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.

3. Use cast iron boxes where exposed galvanized steel rigid metal conduit is used.

4. Use nonmetallic boxes where exposed rigid PVC conduit is used.

5. Use suitable concrete type boxes where flush-mounted in concrete.

6. Use suitable masonry type boxes where flush-mounted in masonry walls.

7. Use raised covers suitable for the type of wall construction and device configuration where required.

8. Use shallow boxes where required by the type of wall construction.

9. Do not use "through-wall" boxes designed for access from both sides of wall.

10. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.

11. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.

12. Nonmetallic Boxes: Comply with NEMA OS 2, and list and label as complying with UL 514C.

13. Boxes for Supporting Luminaires: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.

14. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.

15. Wall Plates: Comply with Section 26 2726.

C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:

1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.

2. Provide block-off plates for all existing cabinets, enclosures, and boxes in which are existing to remain but have had conduits/circuits remoived. To clarify, cabinets, enclosures, and boxes are to be 100% closed with no openings upon completion of project. Contract to field verify.

3. NEMA 250 Environment Type, Unless Otherwise Indicated:

    a. Indoor Clean, Dry Locations: Type 1, painted steel.

    b. Indoor Process rooms: Type 4X, Stainless steel.

    c. Outdoor Locations: Type 4X, stainless steel.

    d. Hazardous Locations: Type 7 (explosion proof).

4. Junction and Pull Boxes Larger Than 100 cubic inches:

    a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.

5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.

D. Boxes for Hazardous (Classified) Locations: Listed and labeled as complying with UL 1203 for the classification of the installed location.

1. Manufacturers:

    a. Appleton, a brand of Emerson Electric Co: www.emerson.com/#sle.

    b. Cooper Crouse-Hinds, a division of Eaton Corporation: www.cooperindustries.com/#sle.

    c. Hubbell Incorporated; Killark Products: www.hubbell-killark.com/#sle.

E. Underground Boxes/Enclosures:

1. Description: In-ground, open bottom boxes furnished with flush, non-skid, gasketed covers with legend indicating type of service and stainless steel tamper resistant cover bolts.

2. Size: As indicated on drawings.

3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches.

4. Provide logo on cover to indicate type of service.

5. Refer to spec section 26 0543 for additional info.

6. Polymer Concrete Underground Boxes/Enclosures: Comply with SCTE 77.

    a. Manufacturers:

        1) Hubbell Incorporated; Quazite Products: www.hubbellpowersystems.com

        2) Oldcastle Precast, Inc: www.oldcastleprecast.com

    b. Combination fiberglass/polymer concrete boxes/enclosures are acceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive boxes.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide separate boxes for emergency power and normal power systems.

E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.

F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.

G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.

H. Box Locations:

1. Locate boxes to be accessible. Provide access panels in accordance with specifications as required.

2. Unless dimensioned, box locations indicated are approximate.

3. Locate boxes as required for devices installed under other sections or by others.

    a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 2726.

4. Locate boxes so that wall plates do not span different building finishes.

5. Locate boxes so that wall plates do not cross masonry joints.

6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.

7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.

8. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.

    a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.

9. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 0534.

I. Box Supports:

1. Secure and support boxes in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.

2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.

3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.

J. Install boxes plumb and level.

K. Flush-Mounted Boxes:

1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.

2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.

3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.

L. Install boxes as required to preserve insulation integrity.

M. Underground Boxes/Enclosures:

1. Install enclosure on gravel base, minimum 6 inches deep.

2. Flush-mount enclosures located in concrete or paved areas.

3. Mount enclosures located in landscaped areas with top at 1 inch above finished grade.

4. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.

5. Refer to contract drawings and specification section 26 0543.

N. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

O. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified.

P. Close unused box openings.

Q. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.

R. Provide grounding and bonding in accordance with Section 26 0526.

S. Identify boxes in accordance with Section 26 0553.

3.3 CLEANING

A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.4 PROTECTION

A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

SECTION 26 0543 - UNDERGROUND ELECTRICAL WORK

PART 1 - GENERAL

1.1 DESCRIPTION:

A. Under this Section, the Contractor shall furnish all labor, materials and equipment for Underground Electrical Work, as shown on the Plans, as specified, and/or directed.

1.2 REFERENCES:

A. The publications listed below and their latest revisions form a part of this Specification. Adhear to applicable sections of the following publications:

1. American National Standards Institute (ANSI) Publications.
2. American Society for Testing and Materials (ASTM) Publications
3. Institute of Electrical and Electronics Engineers (IEEE) Publications.
4. National Fire Protection Association (NFPA) Publications:
5. American Concrete Institute (ACI) Publications:
6. Underwriters Laboratories (UL)
7. National Electrical Manufacturer's Association (NEMA) Publications

B. GENERAL REQUIREMENTS: Specification section 26 0510, applies to this Section with additions and modifications specified herein.

C. Underground Service: Terminate underground service into buildings at interior terminating points indicated. Protect ends of underground conduit with threaded metal caps until connections are made.

D. SUBMITTALS:

1. Shop Drawings (S) or Manufacturer’s Data (M):

a. Cable (M)

b. Conduit (M)

c. Splice kits (M)

d. Insulating tape (M)

e. Hand hole frames and covers (S) (M)

f. Cable lubricants (M)

g. Sealing materials for hand hole joints (M)

2. Manufacturer's Instructions:

   a. Manufacturer's directions for use of ground megger with proposed method indicated.

   b. Terminator manufacturer's installation instructions.

3. Certificates of Compliance:

4. Materials and Equipment: Provide manufacturer's statement certifying that the product supplied meets or exceeds contracts requirements.

   a. Hand holes and accessories.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT: PROVIDE MATERIALS AND EQUIPMENT LISTED BY UL OR APPROVED BY FACTORY MUTUAL (FM) SYSTEM WHEN SUCH EQUIPMENT IS LISTED OR APPROVED.

A. Conduit (also reference specification section 26 0534 for additional requirements): Shall be as indicated on the Contract Drawings Raceway Schedule conforming to the following:

1. Rigid galvanized steel conduit and fittings shall conform to the requirements of UL 6 and UL 1242, for threaded type, respectively, and shall be coated with a polyvinyl chloride (PVC) sheath bonded to the galvanized exterior surface, nominal 40 mils thick, conforming to NEMA RN 1, Type A40, except that hardness shall be nominal 85 Shore A durometer, dielectric strength shall be minimum 400 volts per mil at 60 Hz, tensile strength shall be minimum 3500 psi, and aging shall be minimum 1000 hours in an Atlas Weatherometer.

2. Plastic conduit for direct burial shall be PVC conforming to NEMA TC 2 (conduit) and NEMA TC 3 (fittings). Type shall be as indicated on Contract Drawings.

3. Plastic Insulating Tape: UL 510.

4. Outlet boxes for use with rigid or flexible steel conduit shall be cast metal cadmium or zinc coated if of ferrous metal with gasketed closures and shall conform to UL 514A. Fittings for steel conduit and outlet boxes shall conform to UL 514B.

5. Refer to specification section 26 0534 and raceway schedule on Contract Drawings for additional requirements/information.

B. WIRE & CABLE:

1. Wire and cable conductor sizes are designated by American Wire Gauge (AWG) and Thousands of Circular Mils (MCM). Conductor and conduit sizes indicated are for copper conductors, unless otherwise noted. Insulated conductors shall bear the date of manufacture imprinted on the wire insulation with other identification. Wire and cable manufactured more than 24 months before delivery to the job site shall not be used.

2. Conductors rated 600 volts and less, including service entrances, shall conform to UL 854, Type XHHW-2. Conductor size and number of conductors in each cable shall be as indicated. Cable shall be color coded. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Conductor identification shall be by color-coded insulated conductors, plastic-coated self-sticking printed markers, colored nylon cable ties and plates, or heat shrink type sleeves. Control circuit terminations shall be properly identified.

3. Shielded control wire shall be direct burial rated, insulated twisted pair #18 copper conductors with braid or tape shields, number of pairs per cable as scheduled on the Contract Drawings.

4. Pull Wire: Shall be plastic, having a minimum tensile strength of 200 pounds.

5. Connectors and Terminals: Shall be designed and approved for use with the associated conductor material, and shall provide a uniform compression over the entire contact surface. Solderless terminal lugs shall be used on stranded conductors

6. Grounding and Bonding Equipment: UL 467. Ground rods shall be copperweld type copper clad steel with diameter adequate to permit driving to full length of the rod, but not less than 3/4 inch in diameter and 10 feet long unless otherwise indicated.

7. Refer to additional specification sections for additional requirements/information.

C. Handholes (where shown on the Contract Drawings):

1. Power and data pull boxes shall be constructed of polymer concrete with steel and/or fiberglass reinforcement. Hand holes shall be non-conductive, fire retardant material, skid resistant, gasketed cover. Provide Penta bolts. Provide logo on cover (Electric). Provide complete assembly with cable entry openings. Hand Holes to be sized in accordance with NEC article 314.30. Covers shall be capable of being locked into position. Hand holes must meet all requirements of ANSI/SCTE 77. Manufactured by Quazite, CDR, Hubbell Enclosures, Oldcastle, or approved equal. Polymer concrete/fiberglass pull boxes. Provide split handhole with permanent divider for all hand hole to be used for power and communication/control circuits. Refer to the contract drawings for additional information.

WIRE & CABLE:

3.1 INSTALLATION: UNDERGROUND INSTALLATION SHALL CONFORM TO ANSI C2 AND NFPA 70 EXCEPT AS OTHERWISE SPECIFIED OR INDICATED.

A. Contractor Damage: The Contractor shall promptly repair any indicated utility lines or systems damaged by Contractor operations. Damage to lines or systems not indicated, which are caused by Contractor operations, shall be treated as “Changes” under the terms of the General Provisions of the Contract. If the Contractor is advised in writing of the location of a non-indicated line or system, such notice shall provide that portion of the line or system with “indicated” status in determining liability for damages. In any event, the Contractor shall immediately notify the Engineer of any such damage.

B. Underground ducts without concrete encasement: Conduits shall be per the Raceway Schedule on the Contract Drawings.

C. The top of the conduit shall be not less than 24 inches below grade, shall have a minimum slope of 3 inches in each 100 feet away from buildings and toward manholes and other necessary drainage points, and shall run in straight lines except where a change of direction is necessary. As each conduit run is completed, a testing mandrel not less than 12 inches long with a diameter 1/4 inch less than the inside diameter of the conduit shall be drawn through each conduit, after which a stiff bristled brush shall be drawn through until the conduit is clear of earth, sand, or gravel particles. Conduit plugs shall then immediately be installed. Ensure a minimum 3 inch clearance from the conduit to each side of the trench. Grade the bottom of the trenches smooth; where rock, soft spots, or sharp edged materials are encountered, excavate the bottom for an additional 3 inches; fill with sand or earth, free from particles that would be retained on a 1/4 inch sieve; and tamp level with the original bottom.

D. Under roads and paved areas, install conduits in reinforced concrete encasement of rectangular cross section providing a minimum of 3 inch concrete cover around ducts. The concrete encasement shall extend at least 5 feet beyond the edges of paved areas and roads.

E. Separate multiple conduits with a minimum concrete thickness of 2 inches, except that light and power conduits shall be separated from control, signal, and telephone conduits by a minimum distance of 3 inches. Stagger the joints of the conduits by rows and layers to strengthen the conduit assembly. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly shall consist of base spacers, intermediate spacers, and top spacers to provide a completely enclosed and locked in conduit assembly. Install spacers per manufacturer's instructions, but provide a minimum of two spacer assemblies per 10 feet of conduit assembly.

F. Duct banks, except at conduit risers, with changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, shall be accomplished by long sweep bends having a minimum radius of curvature of 25 feet; sweep bends may be composed of one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius of 24 inches for use with conduits of less than 3 inches in

diameter and a minimum radius of 36 inches for ducts of 3 inches in diameter and larger. Excavate trenches along straight lines.

G. New conduit indicated as being unused or empty shall be provided with plugs on each end. Plugs shall contain a weep hole or screen to allow water drainage. Provide a plastic pull rope having 3 feet of slack at each end of unused or empty conduits.

H. Underground Conduit for Service Into Buildings: Shall be rigid steel from the service equipment to a point 5 feet beyond the building and projections thereof. Protect the ends of the conduit by threaded metal caps or bushings; coat the threads with graphite grease or other coating. Clean and plug conduit until conductors are installed.

I. Concrete for Electrical Requirements: Shall be composed of fine and coarse aggregate, Portland cement, and water proportioned and mixed to produce a plastic, workable mixture. Fine aggregate shall be of hard, dense, durable, clean, and uncoated sand. The coarse aggregate shall be 3/16 inch to 1 inch size. The fine and coarse aggregates shall not contain dirt, vegetable matter, soft fragments, or other deleterious substances. Water shall be fresh, clean, and free from salts, alkali, organic matter, and other impurities. Concrete shall be 3000 psi minimum ultimate 28 day compressive strength. Slump shall not exceed 4 inches. Retempering of concrete will not be permitted. Exposed, unformed concrete surfaces shall be given a smooth, wood float finish. Concrete shall be cured for a period of not less than 7 days, and concrete made with high early strength Portland cement shall be repaired by patching honeycombed or otherwise defective areas with cement mortar as directed. Air entrain concrete exposed to weather using an air entraining admixture conforming to ASTM C260. Air content shall be between 4 and 6 percent.

J. Buried Utility Warning and Identification Tape: Provide detectable aluminum foil plastic backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried cable and conduit. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 2 inches minimum width, color coded for the utility involved with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall be CAUTION BURIED ELECTRIC CABLE BELOW or similar. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material. Bury tape with the printed side up at a depth of 12 inches below the top surface of earth or the top surface of the subgrade under pavements.

K. Unpaved surfaces disturbed during the installation of duct or direct burial cable shall be restored to the original elevation and condition. Sod or topsoil shall be preserved carefully and replaced after the backfilling is completed. Replace damaged sod with sod of equal quality. Where the surface is disturbed in a newly seeded area, the disturbed surface shall be reseeded with the same quantity and formula of seed as that used in the original seeding.

L. Paving Repairs: Where trenches, pits, or other excavations are made in existing roadways and other areas of pavement where surface treatment of any kind exists, such surface treatment or pavement shall be restored to the same thickness and in the same kind as previously existed, except as otherwise specified, and to match and tie into the adjacent and surrounding existing surfaces in a neat and acceptable manner.

M. Cable Pulling: Test existing ducts with a mandrel and thoroughly swab out to remove foreign material before the pulling of cables. Cable lubricants shall be soapstone, graphite, or talc for rubber or plastic jacketed cables. Cable pulling tensions shall not exceed the maximum pulling tension recommended by the cable manufacturer. Do not exceed the specified cable bending radii when installing cable under any conditions, including turnups into switches, transformers, switchgear, switchboards, and other enclosures. Cable with tape shield shall have a bending radius not less than 12 times the overall diameter of the completed cable. Cable with wire shield shall have a bending radius not less than eight times the overall diameter of the completed cable. If basket grip type cable pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.

N. Secondary cable runs, 600 volts and less, shall include an insulated copper equipment grounding conductor sized as required by the rating of the overcurrent device supplying the phase conductors.

O. Excavating, Backfilling, and Compacting: Excavate to depths indicated. If hard material is encountered, the provisions of the contract respecting an adjustment for changed conditions shall apply, subject to the requirements of notification thereunder being given. Hard material shall be defined as solid rock; firmly cemented unstratified masses; conglomerate deposits possessing the characteristics of solid rock not ordinarily removed without systematic drilling and blasting; or any boulder, masonry, or concrete (except pavement) exceeding 1/2 cubic yard in volume.

P. Excavated materials not required or suitable for backfill shall be removed from the project site. Provide sheeting and shoring as necessary for protection of work and safety of personnel. Remove water from excavation by pumping or other approved method.

Q. Backfilling around structures shall consist of earth, loam, sand clay, or sand and gravel, free from large clods of earth or stones over 1 inch in size. Backfill materials shall be placed symmetrically on all sides in loose layers not more than 9 inches deep. Each layer shall be moistened, if necessary, and compacted with mechanical or hand tampers to 90 percent compaction.

R. Backfilling Around Hand Holes: Provide excavation and backfilling include minimum 6" gravel base under the hand hole assembly with the gravel 3" to 4" wider than the sides of the hand hole. (Internal bracing may be warranted for any manufacturer's underground enclosure if 95% compaction is required or if heavy vehicles are going to be present during construction and/or throughout the life of the enclosure. See manufacturer recommended practices and instruction including applicable sizes that would require internal bracing.)

S. Backfilling Trenches: Place backfill in layers not more than 6 inches thick, and compact each layer. Backfilling shall progress as rapidly as the construction, testing, and acceptance of the work permits. Backfill shall be free from roots, wood scrap material, and other vegetable matter and refuse. Compaction of backfill shall be to 90 percent of ASTM D698 density. The first layer shall be earth or sand, free from particles that would be retained on a 1/4 inch sieve and extending not less than 3 inches above the top of the conduit or cables. The succeeding layers shall be excavated material having stones no larger than would pass through a 4 inch ring. The backfill may be moistened. The backfill

shall be level with the adjacent surface, except that in sodded areas, leave a space equal to the thickness of the sod.

T. Splices for 600 Volt Class Cables: Splices in underground systems shall be made only in accessible locations such as hand holes, using a compression connector on the conductor and by insulating and waterproofing by one of the following methods suitable for continuous submersion in water.

    1. Cast type splice insulation shall be provided by means of a molded casting process employing a thermosetting epoxy resin insulating material which shall be applied by a gravity poured method or by a pressure injected method. The component materials of the resin insulation shall be in a packaged form ready for convenient mixing without removing from the package. Do not allow the cables to be moved until after the splicing material has completely set.

    2. Gravity poured method shall employ materials and equipment contained in an approved commercial splicing kit which includes a mold suitable for the cables to be spliced. When the mold is in place around the joined conductors, prepare and pour the resin mix into the mold. Do not allow cables to be moved until after the splicing materials have completely set.

U. Grounding: Noncurrent carrying metallic parts associated with electrical equipment shall have a maximum resistance to solid earth ground not exceeding values established within the IEEE Green Book: Where values are not listed within the IEEE Green Book, resistance to solid earth ground shall not exceed 25 ohms.

V. Grounding electrodes shall be cone pointed ground rods, driven full depth plus 6 inches, installed when indicated to provide an earth ground of the appropriate value for the equipment being grounded.

W. Grounding connections which are buried or otherwise normally inaccessible, and excepting specifically those connections for which access for periodic testing is required, shall be made by exothermic weld or compression connector. Exothermic welds shall be made strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces, indicating improper cleaning, are not acceptable. Mechanical connectors are not required at exothermic weldments. Compression connector shall be the type which uses a hydraulic compression tool to provide the correct circumferential pressure. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.

X. Grounding conductors shall be stranded bare copper conforming to ASTM B8, Class B, for sizes No. 6 AWG and larger, and shall be solid bare copper conforming to ASTM B1 for sizes No. 8 and smaller. Surge arresters shall be grounded to ground rods with No. 4 AWG.

Y. Special Conditions: During the construction of duct banks located in streets, the streets shall remain open to traffic. Plan and execute the work to meet this condition.

Z. Field Tests: As an exception to requirements that may be stated elsewhere in the Contract, notify the Engineer in writing at least 5 working days prior to each test. Furnish labor, equipment, and incidentals required for testing, except that the Owner will provide electric power required for the tests. Correct defects in the work provided by the Contractor and repeat tests until the work is in compliance with contract requirements. Show by demonstration in service that circuits and devices are in good operating condition. Tests shall be such that each item of control equipment will function not less than five times.

AA. Distribution Conductors 600 Volt Class: After wiring is completed and connected ready for operation, but prior to placing systems in service and before any branch circuit breakers are closed, perform insulation resistance tests in all circuits. Measure the insulation resistance between conductors and between each conductor and ground. Use an instrument capable of making measurements at an applied potential of 500 volts. Take readings after the voltage has been applied for a minimum of 1 minute. The minimum insulation resistance for circuits of No. 12 AWG conductors shall be 1,000,000 ohms.

AB. Ground Rods: Test ground rods for ground resistance value before any wire is connected. Perform ground resistance measurements in normally dry weather, not less than 48 hours after rainfall. Ground resistance shall also be measured for each piece of equipment to the ground electrode. Use a portable ground testing megger to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground electrode under test. Provide one copy of the ground megger manufacturer's directions, indicating the method to be used.

AC. Compaction: Backfill shall be tested in accordance with ASTM D1556, one test per lift per 2000 square feet.

END OF SECTION

SECTION 26 0553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electrical identification requirements.

B. Identification nameplates and labels.

C. Wire and cable markers.

D. Voltage markers.

E. Underground warning tape.

F. Floor marking tape.

G. Warning signs and labels.

1.2 RELATED REQUIREMENTS

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.

B. Section 26 0573 - Power System Studies: Arc flash hazard warning labels.

1.3 REFERENCE STANDARDS

A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2011.

B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2011.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.

B. Sequencing:

1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.

2. Do not install identification products until final surface finishes and painting are complete.

1.5 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.

B. Shop Drawings: Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of product.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

1.7 FIELD CONDITIONS

A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 - PRODUCTS

2.1 IDENTIFICATION REQUIREMENTS

A. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.

B. Identification for Equipment:

1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.

a. Switchboards:

1) Identify ampere rating.

2) Identify voltage and phase.

3) Identify power source and circuit number. Include location.

4) Use identification nameplate to identify main overcurrent protective device.

5) Use identification nameplate to identify load(s) served for each branch device. Identify spares and spaces.

b. Motor Control Centers:

1) Identify ampere rating.

2) Identify voltage and phase.

3) Identify power source and circuit number. Include location.

4) Use identification nameplate to identify main overcurrent protective device.

5) Use identification nameplate to identify load(s) served for each branch device. Identify spares and spaces.

c. Panelboards:

1) Identify ampere rating.

2) Identify voltage and phase.

3) Identify power source and circuit number. Include location.

4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.

5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.

6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Identify spares and spaces.

d. Transformers:

1) Identify kVA rating.

2) Identify voltage and phase for primary and secondary.

3) Identify power source and circuit number. Include location.

4) Identify load(s) served. Include location.

e. Enclosed switches, circuit breakers, and motor controllers:

1) Identify voltage and phase.

2) Identify power source and circuit number. Include location.

3) Identify load(s) served. Include location.

f. Time Switches (includes programmable time switches):

1) Identify load(s) served and associated circuits controlled. Include location.

g. Transfer Switches:

1) Identify voltage and phase.

2) Identify power source and circuit number for both normal power source and standby power source. Include location.

3) Identify load(s) served. Include location.

4) Identify short circuit current rating based on the specific overcurrent protective device type and settings protecting the transfer switch.

h. Electricity Meters:

1) Identify load(s) metered.

2. Service Equipment:

a. Use identification nameplate to identify each service disconnecting means.

b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.

3. HVAC ventilation equipment

a. Identify alarm lights/horns using identification nameplates. Each warning light/horn to be identified with appropriate nameplate.

4. Gas Detection System

a. Identify Gas Sensors, Transmitters, alarm lights/horns, and Control Panel using identification nameplate.

5. Emergency System Equipment:

a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.

b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.

c. Use identification nameplate to identify emergency operating instructions for emergency system equipment.

6. Use voltage marker to identify highest voltage present for each piece of electrical equipment.

7. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.

8. Use identification label or handwritten text using indelible marker on inside of door at each fused switch to identify required NEMA fuse class and size.

9. Use identification label or handwritten text using indelible marker on inside of door at each motor controller to identify nameplate horsepower, full load amperes, code letter, service factor, voltage, and phase of motor(s) controlled.

10. Use identification label to identify overcurrent protective devices for branch circuits serving fire alarm circuits. Identify with text "FIRE ALARM CIRCUIT".

11. Use field-painted floor markings, floor marking tape, or warning labels to identify required equipment working clearances where indicated or where required by the authority having jurisdiction.

    a. Field-Painted Floor Markings: Alternating black and white stripes, 3 inches wide, painted in accordance with painting specifications.

12. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70, including but not limited to the following.

    a. Service equipment.and automatic transfer switch

    b. switchboards, panelboards, and Industrial control panels.

    c. Motor control centers.

13. Arc Flash Hazard Warning Labels: Comply with Section 26 0573.

C. Identification for Conductors and Cables:

1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 0519.

2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment.

3. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:

    a. At each source and load connection.

    b. Within boxes.

    c. Within equipment enclosures.

    d. In cable tray, at maximum intervals of 10 feet.

4. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.

5. Use underground warning tape to identify direct buried cables.

D. Identification for Raceways:

1. Use voltage markers to identify highest voltage present for accessible conduits at maximum intervals of 10 feet.

2. Use voltage markers, color-coded bands, or factory-painted conduits to identify systems other than normal power system for accessible conduits.

    a. Maximum Intervals: 10 feet.

    b. Use Pre-Painted Conduit

    c. Color-Coded Bands: Use vinyl color coding electrical tape to mark bands 3 inches wide.

        1) Vinyl Color Coding Electrical Tape: Comply with Section 26 0519.

    d. Color Code:

        1) Fire Alarm System: Red.

3. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations.

4. Use identification labels, handwritten text using indelible marker, or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.

5. Use underground warning tape to identify underground raceways.

6. Use voltage markers to identify highest voltage present for wireways at maximum intervals of 10 feet.

E. Identification for Boxes:

1. Use voltage markers to identify highest voltage present.

2. Use voltage markers or color coded boxes to identify systems other than normal power system.

    a. Color-Coded Boxes: Field-painted per the following color code:

        1) Fire Alarm System: Red.

3. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.

4. Use warning labels to identify electrical hazards with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".

F. Identification for Devices:

1. Wiring Device and Wallplate Finishes: Comply with Section 26 2726.

2. Use identification label to identify fire alarm system devices.

3. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.

4. Use identification label or engraved wallplate to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.

G. Identification for Luminaires:

1. Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system, including luminaires with integral emergency battery back-up.

2.2 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:

1. Materials:

    a. Indoor Clean, Dry Locations: Use plastic nameplates.

    b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.

2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.

3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.

4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.

5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.

B. Identification Labels:

1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.

a. Use only for indoor locations.

2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:

1. Minimum Size: 1 inch by 2.5 inches.

2. Legend:

a. Equipment designation or other approved description.

3. Text: All capitalized unless otherwise indicated.

4. Minimum Text Height:

a. Equipment Designation: 1/2 inch.

b. Exception: Provide minimum text height of 1 inch for equipment located more than 10 feet above floor or working platform.

5. Color:

a. Normal Power System: White text on black background.

b. Fire Alarm System: White text on red background.

2.3 WIRE AND CABLE MARKERS

A. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.

B. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.

C. Legend: Power source and circuit number or other designation indicated.

D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.

E. Minimum Text Height: 1/8 inch.

F. Color: Black text on white background unless otherwise indicated.

2.4 VOLTAGE MARKERS

A. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.

B. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.

C. Minimum Size:

1. Markers for Equipment: 1 1/8 by 4 1/2 inches.

2. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.

3. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.

4. Markers for Junction Boxes: 1/2 by 2 1/4 inches.

D. Legend:

1. Markers for Voltage Identification: Highest voltage present.

2. Markers for System Identification:

a. Emergency Power System: Text "EMERGENCY".

b. Other Systems: Type of service.

E. Color: Black text on orange background unless otherwise indicated.

2.5 UNDERGROUND WARNING TAPE

A. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.

B. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.

C. Legend: Type of service, continuously repeated over full length of tape.

D. Color:

1. Tape for Buried Power Lines: Black text on red background.

2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.6 FLOOR MARKING TAPE

A. Floor Marking Tape for Equipment Working Clearance Identification: Self-adhesive vinyl or polyester tape with overlaminate, 3 inches wide, with alternating black and white stripes. Contractor to provide for all panelboards, switchboards, and motor control centers.

2.7 WARNING SIGNS AND LABELS

A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.

B. Warning Signs:

1. Materials:

a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.

b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.

2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.

3. Minimum Size: 7 by 10 inches unless otherwise indicated.

C. Warning Labels:

1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.

2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.

3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:

1. Surface-Mounted Equipment: Enclosure front.
2. Flush-Mounted Equipment: Inside of equipment door.
3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
4. Elevated Equipment: Legible from the floor or working platform.
5. Branch Devices: Adjacent to device.
6. Interior Components: Legible from the point of access.
7. Conduits: Legible from the floor.
8. Boxes: Outside face of cover.
9. Conductors and Cables: Legible from the point of access.
10. Devices: Outside face of cover.

C. Install identification products centered, level, and parallel with lines of item being identified.

D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.

1. Do not use adhesives on exterior surfaces except where substrate cannot be penetrated.

E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.

F. Install underground warning tape above buried lines with one tape per trench at 3 inches below finished grade.

G. Secure rigid signs using stainless steel screws.

H. Mark all handwritten text, where permitted, to be neat and legible.

3.3 FIELD QUALITY CONTROL

A. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION

SECTION 26 0573 - POWER SYSTEM ANALYSIS

PART 1 - GENERAL

1.1 1.1 DESCRIPTION:

A. Under this Section, the Contractor shall provide a Power System Analysis as prepared by an approved engineering firm.

B. The Power System Analysis shall include short-circuit analysis study, protective device coordination study, and an arc flash hazard analysis study.

C. SCOPE: The scope of the Power System Analysis shall include all new distribution equipment supplied under this Contract. The study to also include all existing to remain distribution equipment as shown on the electrical single line diagrams. Intent is to provide a complete power system study for the etire project. The Power System Analysis shall be performed to account for all normal and emergency sources of power.

1. Note, the scope of this study is to also include any control panels which are supplied by others and shown on the electrical drawings. Contractor to coordinate with applicable trade contractor, owner, and engineer to obtain necessary information to complete study.

2. Contractor to field verify and include within the analysis all existing electrical distribution equipment on site as shown on the single line diagrams on the contract drawings.

3. Provide NFPA 70E compliant Arc Flash training.

D. REFERENCES: The publications listed below and their latest revisions form a part of this Specification. Adhear to applicable sections of the following publications:

1. American National Standards Institute (ANSI) Publications.

2. Institute of Electrical and Electronics Engineers (IEEE) Publications.

3. National Fire Protection Association (NFPA) Publications:

4. National Electric Code (NEC)

5. OSHA

E. RELATED REQUIREMENTS: “Basic Electrical Requirements” and "Identification for Electrical Systems", applies to this Section with additions and modifications specified herein.

F. DEFINITION OF ELECTRICAL TERMS: Unless otherwise specified or indicated, electrical terms used in these Specifications, and on the drawings, shall be as defined in IEEE Standard No. 100.

G. SUBMITTALS: The Power System Analysis shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the Engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

1. Report: The results of the Power System Analysis studies shall be summarized in a final report. Provide in electronic PDF format.

2. Report Sections: The report shall include the following sections:

    a. Executive Summary.

    b. Descriptions, purpose, basis and scope of the study.

    c. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short-circuit duties.

    d. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection.

    e. Fault current calculations including a definition of terms and guide for interpretation of the computer printout.

    f. Details of the incident energy and flash protection boundary calculations.

    g. Details of required personal protective equipment (PPE) required to work on the gear in question while energized.

    h. Details of calculated harmonic currents and voltages.

    i. Current and Voltage waveforms at all significant buses and circuits.

    j. Recommendations for system improvements, where needed.

    k. One-line diagram.

3. ARC Flash Hazard Marking: Submittal shall include representative label and report showing required data for all equipment and devices which require an ARC flash label.

H. QUALIFICATIONS:

1. The Power System Analysis shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.

2. The Registered Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer, or an approved engineering firm. The Registered

Professional Electrical Engineer shall have a minimum of three (3) years of experience in performing power system studies.

3. The equipment manufacturer or approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least five actual arc flash hazard analysis it has performed in the past year.

4. COMPUTER ANALYSIS SOFTWARE: The Power System Analysis shall be performed using the latest revision of the SKM Systems Analysis Power*Tools for Windows (PTW) software program, EasyPower 10.2 software, or approved equal.

PART 2 - PRODUCTS

2.1 STUDIES:

A. Contractor to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer, or an approved engineering firm.

B. The Contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D.

C. The Contractor shall provide a harmonics study as prepared by equipment manufacturer, or an approved engineering firm.

2.2 DATA COLLECTION:

A. Contractor shall furnish all data as required for the Power System Analysis. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the Contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

B. Source combination may include present and future motors and generators.

C. Load data utilized may include existing and proposed loads obtained from Contract Documents. Contractor to field verify existing to remain equipment information.

D. If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

E. Contractor to obtain actual utility fault data from the local utility for use within the studies.

2.3 SHORT CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY:

A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standard 141-1993.

B. Transformer design impedances shall be used when test impedances are not available.

C. Provide the following:

1. Calculation methods and assumptions

2. Single line diagram of the system being evaluated

3. Source impedance data, including electric utility system and motor fault contribution

4. System characteristics

5. Tabulations of calculated quantities

6. Results, conclusions, and recommendations

D. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:

1. Electric utility's supply termination point

2. Incoming switchgear

3. Low voltage switchgear/switchboards

4. Motor control center

5. Standby generators and automatic transfer switch

6. Branch circuit panelboard

7. Major equipment disconnects

8. Other significant location throughout the system

E. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.

F. Protective Device Evaluation: Evaluate equipment and protective devices and compare to short-circuit ratings

1. Evaluate the adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses.

2. Notify Owner and Engineer in writing, of existing, circuit protective devices improperly rated for the calculated available fault current.

G. Contractor to label service equipment with the max available fault current per NEC requirements.

2.4 PROTECTIVE DEVICE COORDIANTION STUDY:

A. Proposed protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.

B. Include on each TCC graph, a complete title and one-line diagram with legend identifying the specific portion of the system covered.

C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.

D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

E. Plot the following characteristics on the TCC graphs, where applicable:

1. Electric utility's overcurrent protective device.

2. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.

3. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands.

4. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.

5. Conductor damage curves.

6. Ground fault protective devices, as applicable.

7. Pertinent motor starting characteristics and motor damage points, where applicable.

8. Pertinent generator short-circuit decrement curve and generator damage point.

9. The largest feeder circuit breaker in each motor control center and applicable panelboard.

F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

G. Contractor to field apply all recommended settings (upon completion of the coordination study) to all provided protective devices in which contain settings.

2.5 ARC FLASH HAZARD ANALYSIS:

A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-LATEST EDITION, Annex D.

B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, enclosed circuit breakers, major equipment disconnects, busway and splitters) where work could be performed on energized parts.

C. The Arc-Flash Hazard Analysis shall include all significant locations in the 480Y/277V and 208Y/120V distribution system where work could be performed on energized parts.

D. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm2.

E. Overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.

F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.

G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:

    1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.

    2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).

H. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.

I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

J. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

K. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2018 Section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

L. Contractor to provide Arc Flash Mitigation Study to find the best/most feasible solution possible to reduce incident energy while maintaining the highest degree of reliability and coordiantion.

1. Arc Flash Mitigation Study to be performed for all equipment locations as part of this project that are identified/calculated with an incident energy greater than or equal to 12 cal/cm2.

2. Study to provide design recommendations, associated calculations, associated product data, and indicate incident energy results if recommendations are implemented.

2.6 ARC FLASH WARNING LABELS:

A. Provide a 4 in. x 6 in. thermal transfer type label of high adhesion polyester for each work location analyzed. Labels affixed to equipment enclosures rated NEMA 3R, 4, 4X, 6, or 8 shall be rated for outdoor use.

B. All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.

C. The label shall include the following information, at a minimum:

1. Location designation (Equipment ID)

2. Nominal voltage

3. Arc Flash boundary

4. Incident energy

5. PPE description

6. Working distance

7. Shock protection boundaries (Limited and Restricted)

8. Engineering firm and issue date.

D. Labels shall be machine printed, with no field markings.

PART 3 - EXECUTION

3.1 FIELD ADJUSTMENT:

A. Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer or Contractor under the direct supervision of the engineering firm completing the analysis.

B. Make minor modifications to equipment as required to accomplish conformance with short-circuit and protective device coordination studies.

C. Notify Owner in writing of any required major equipment modifications.

D. ARC FLASH WARNING LABELS:

E. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings. Provide the following:

1. For each 600, 480 and applicable 208 volt panelboard, one arc flash label shall be provided.

2. For each motor control center, one arc flash label shall be provided.

3. For each low voltage switchboard, one arc flash label shall be provided.

4. For each switchgear, one flash label shall be provided.

5. For each major equipment disconnect one arc flash label shall be provided

    a. major equipment disconnects are defined as 30A and larger.

6. For each enclosed circuit breaker one arc flash label shall be provided

3.2 ARC FLASH TRAINING:

A. Contractor to provide NFPA 70E certified arc flash training. For bidding purposes assume training is to take place at the project site and include training for up to five (5) owner representatives.

1. Include one (1) full day of arc flash training at the project site.

END OF SECTION

SECTION 26 0910 - HVAC MONITORING PANELS

PART 1 GENERAL

1.1 DESCRIPTION

A. It is the intent that the Contractor will work with a Systems Integrator to successfully fulfill the requirements herein and shown on the Contract Drawings to provide a complete and operable HVAC monitoring and alarm system with the intent specified and shown on the Contract Drawings.

B. System Integrator referenced throughout this specification is referring to the panel provider.

1.2 SECTION INCLUDES

A. Three (3) HVAC monitoring/alarm panels as follows:

1. HVAC-400 (located at the WWTP ATAD Building).

2. HVAC-500 (located at the WWTP MBR Building).

3. HVAC-700 (located at the WWTP Dewatering Building).

B. Commisioning, Startup Services, & Training

1.3 REFERENCE STANDARDS

A. All control systems as specified herein shall be provided in accordance with the latest editions of the National Electrical Code (NEC) and IEC.

B. All wiring shall be in complete conformance with the NEC, state, local, and NEMA electrical standards. All incoming and outgoing wires shall be connected to numbered terminal blocks and all wiring neatly tied and fastened to chassis as required.

C. All control panels shall be Underwriters Laboratories (UL) 508A and/or UL 698A listed whichever may be applicable. The UL 508A and/or UL 698A “sticker” shall be clearly displayed in the appropriate location within the panel. Third party substitutions of UL 508A and/or UL 698A listed equipment shall be strictly prohibited.

D. All equipment and installations shall satisfy applicable federal, state, and local codes.

E. Furnish products listed and classified by UL, CSA, or FM approval as suitable for purpose specified and indicated.

F. Auxiliary and accessory devices necessary for system operation or performance, such as transducers, relays, signal amplifiers, intrinsic safety barriers, signal isolators, hardware, software, and drivers to interface with existing equipment or equipment provided by

others under other sections of these specifications, shall be included whether they are shown on the drawings or not.

1.4 RELATED SECTIONS

A. All Division 26 specifications.

B. Contractor to coordinate sequence of operation with the engineer and owner.

1. Contractor to include two (2) 4-hour meetings with the engineer and owner to discuss/finalize sequence of operation in which control system is to be programmed for.

a. Meetings to take place at the project site.

1.5 SUBMITTALS

A. The Systems Integrator shall prepare for review, provide to the Contractor, for submission to the Engineer, three hard copy sets and one electronic copy (USB) of the following documentation:

1. Written sequence of control system operation (coordinate as required with the owner and engineer).

2. Electrical and mechanical schematic drawings.

3. Bill of Materials.

4. Vendor data sheets.

5. Control system warranty (Article 1.7).

1.6 OPERATIONS AND MAINTENANCE DOCUMENTATION

A. The Systems Integrator shall provide three hard copy sets and one electronic copy (USB) of the following Operations and Maintenance documentation to the Contractor. All documentation shall be neatly bound in three-ring binders.

1. Final written sequence of control system operation (coordinate as required with the owner and engineer).

2. As-installed electrical and mechanical schematic drawings.

3. Bill of Materials.

4. Vendor operation, maintenance and troubleshooting documentation.

5. Control system warranty (Article 1.7).

1.7 WARRANTY

A. The Systems Integrator shall provide with the above submittals, a written parts and labor warranty against system failure for 12 months from system startup, not to exceed 18 months from date of shipment from their factory. This warranty period will, with the exception of human negligence or acts of nature such as lightning, floods, etc., provide for repair of any and all defects of workmanship, as well as repair or replacement of any defective or failed components, at the project site, and at no cost to others.

1.8 QUALITY ASSURANCE

A. The equipment, controls and accessories covered in this specification section constitute a completely integrated system, designed, constructed, programmed, and tested by one Systems Integrator, accountable for its operation and performance. The Systems Integrator named hereafter has been chosen as the basis of design based on their ability to Engineer, design, and manufacture systems of the type herein specified. In addition, they possess a New York State-based, factory trained service staff experienced in routine and emergency service of the type of equipment herein specified.

B. The Contractor shall submit to the Engineer the name of the System Integrator to whom they propose to award the work. No Systems Integrator will be approved by the Engineer who cannot furnish satisfactory proof of at least five successful installations which in the judgment of the Engineer are of equal or greater complexity to that described herein.

C. The Systems Integrator shall be a reputable firm that has been in the business of providing automated control systems specifically for the water and wastewater treatment industry for a minimum of 10 years. Systems Integrators with less than 10 years of experience will not be accepted.

D. The Systems Integrator shall have as a minimum, five full-time employees whom are experienced in routine and emergency services of the equipment herein specified. The Systems Integrator shall as a minimum provide 2 direct cell phone numbers in which service personnel can be reached 24 hours, 7 days per week.

E. The Systems Integrator shall be UL approved for manufacturing systems in compliance with UL 508A and/or UL 698A whichever may be applicable. Each assembly and subassembly of the system shall be listed and labeled as UL approved. Systems Integrators whom outsource panel fabrication services for the purpose of providing UL labeling will not be accepted.

F. The Systems Integrator shall be AquaLogics Systems, Inc., 5 Dwight Park Drive, Syracuse, NY 13209, Phone: (315) 413-0400 or approved equal.

G. Control panels shall be fabricated with the following features as a minimum:

    1. All subpanel wiring shall be run in plastic wire duct sized with 50 percent spare space, AC and DC wiring shall be run in separate wire ducts.

2. All power supplies shall be sized for an additional 50 percent spare ampacity over expected load. Each power supply shall include an AC input fuse and independent output fuses for each device requiring DC power.

3. All field terminations shall be made on compression type terminal blocks labeled according to wire number, separate terminal strips shall be provided for AC and DC signals. A minimum of 20 percent spare terminals shall be provided.

4. Wiring to door mounted components shall be neatly bundled wiring harnesses protected by plastic spiral wire wrap when crossing door hinge. Wiring harnesses shall have adequate stress loops and be fastened at both sides of hinge crossing.

5. All wiring shall be wire numbered at both ends with plastic Brady type labels.

6. All nameplates shall be engraved on lamacoid material providing black lettering on a white background. Lettering shall be no smaller than 1/8 inch in height.

7. 20 percent spare mounting space (panel internal) is required for future modifications.

H. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.

1.9 ENVIRONMENTAL CONTROL OF PANELS

A. Control Panels shall be provided with louvers, or forced air ventilation as required to prevent temperature buildup inside of panel. Internal temperature of all panels shall be regulated to a range of 45 to 104 degrees F under all conditions. Under no circumstances shall panel cooling or heating equipment compromise the NEMA rating of the panel.

B. Louvers and fans shall be located on the sides of the panels.

C. Forced air ventilation fans, where used, shall provide a positive internal pressure within the panel, and shall be provided with washable or replaceable filters. Fan motors shall operate on 120-volt, 60 Hertz power.

1.10 OVERVIEW OF OPERATION

A. The System Integrator shall supply for contractors installation the HVAC monitoring/alarm control panels (CP) specified herein for monitoring/control of the HVAC ventilation system where ventilation is used to derate a classified space. The CP shall through hardwired status and alarm signals monitor the ventilation system as indicated on the Contract Drawings.

B. The control panels shall provide local alarm monitoring by door mounted common alarm lights, momentary pushbutton, (for alarm acknowledgement, reset, and horn silence) and alarm horn.

C. Upon a loss of adequate air flow or a ventilation fan failure, the control panel is to energize the appropriate LED warning light and sounder/horn. Coordinate final requirements closely with the HVAC contractor, owner, and engineer.

D. Provide all hardware and services as herein specified to provide one (1) completely factory assembled control panel.

E. System commissioning and startup services associated with the specified HVAC panels are to be provided as part of this contract/specification.

F. Contractor and Systems Integrator to provide two (2) 4-hour meetings with the owner/engineer at the project site to discuss control panel sequence of operation.

    1. Coordinate meeting with owner/engineer two weeks in advance and prior to submittal documentation submission.

G. Refer to Contract Drawings for intent and all equipment/components that control panels are to interface with.

1.11 SEQUENCE OF OPERATION

A. Control panels to be completely factory programmed as required to provide the control strategies outlined during the owner/engineer meeting. All control strategies to be fully coordinated with the owner and engineer. Refer to above required meetings to review sequence and finalize programming requirements.

PART 2 PRODUCTS

2.1 HVAC MONITORING/ALARM CONTROL PANELS

A. Each control panel shall be housed in a NEMA 12 wall mount enclosure constructed of 14 gauge steel with white polyester powder paint inside, ANSI 61 gray polyester powder paint outside over phosphatized surfaces. The enclosure shall be sized as required to house equipment specified and perform intended operations specified. The enclosure shall be Hoffman, or approved equal. Refer to Contract Drawings for mounting location information.

B. Control panels shall be UL 508A listed. The UL 508A “sticker” shall be clearly displayed in the appropriate location within the panel. Third party substitutions of UL 508A listed equipment shall be strictly prohibited.

C. Control panel input power shall be 120VAC, 1 phase, 60 Hertz. Provide a sufficiently sized main circuit breaker disconnecting means. Interlock main circuit breaker disconnect with the control panel door handle.

D. Refer to Electrical Drawings for additional requirements.

E. A 120VAC single phase surge protector shall be provided for the incoming 120VAC supply. The surge protector shall be designed to protect electrical and electronic equipment against transients caused by lightning, induction, load switching, EMP and other sources. Line to neutral, line to ground and neutral to ground protection shall be provided. The surge protector shall have a protection level of 1kV and a maximum discharge current of 140 kA as a minimum. The surge protector shall have a remote signaling device for fault indication to the PLC. The AC surge protector shall be CITEL model DS72RS-120 or approved equal.

F. Short circuit protection of 120VAC input power shall be provided by a miniature branch rated circuit breaker with an interruptive capacity of 10K amperes at 240VAC. Circuit Breakers shall be Allen-Bradley 1489 series or approved equal

G. One print pocket shall be provided on each control panel inner door. One complete set of electrical control drawings shall be provided in the pocket.

H. Separate circuit breaker disconnects for each load supplied from each control panel shall be provided. All branch circuits shall be short circuit protected.

I. Control panel shall be provided with a DC power supply: a 24V direct current power supply shall be provided to power all ancillary equipment. The power supply shall have an operational input range of 85 to 132VAC and shall have a minimum rated output of 24 to 28VDC/240 watts. Power supply shall be PULS QS10.241 or approved equal.

J. The control panel shall provide visual alarm annunciation via common alarm pilot light and alarm horn for each ventilation fan monitored. Pilot lights shall be 30mm, industrial grade, push-to-test type, Allen-Bradley 800T series or approved equal.

K. Control panel shall provide audible alarm annunciation via alarm horn. Alarm horn shall provide a typical sound pressure of 95 + 5 dB(A) at 30VDC, at 24 inches and shall have a built-in volume control providing variable attenuation up to 20 dB(A). The alarm horn shall be Floyd Bell Model MC-V09-530-Q or approved equal.

L. A momentary pushbutton shall be provided for alarm acknowledgment/reset and alarm horn silence (typical of each control panel). Pushbutton shall be 30mm industrial grade, Allen-Bradley 800T Series or approved equal.

M. AC power fuses shall be provided as required for over current protection of individual AC powered panel components. Single circuit fusible terminal blocks with neon blown fuse indicators suitable for use with 1/4-inch x 1-1/4-inch glass fuses shall be provided for each circuit requiring fuse protection. Fusible terminal strips shall have a working voltage rating of 100 to 300VAC, and have a current rating of 12 amps. Fuse blocks shall be Allen-Bradley Model 1492-H4 or approved equal.

N. DC power fuses shall be provided as required for over current protection of individual DC powered panel components. Single circuit fusible terminal blocks with LED blown fuse indicators suitable for use with 1/4-inch x 1-1/4-inch glass fuses shall be provided for each circuit requiring fuse protection. Fusible terminal strips shall have a working voltage

rating of 10 to 57V AC/DC, and have a current rating of 12 amps. Fuse blocks shall be Allen-Bradley Model 1492-H5 or approved equal.

O. Interposing and control relays shall be provided as required. They shall be of industrial grade, plug-in socket type, and shall have 24VDC or 120VAC coils and 2PDT or 4PDT Form C relays as required. All relay contacts shall be silver nickel plated, 2PDT relay contacts shall be rated for 10A at 300VAC and 4PDT relay contacts shall be rated for 7A at 300VAC. All relays shall be provided with a standard On/Off flag indicator, mounting base and retainer clip. Control relays shall be Allen-Bradley Series 700-HC or approved equal.

P. Compression type terminal blocks shall be provided for all field connections, wiring field equipment directly to PLC I/O bases or other panel components is not acceptable. Terminal blocks shall have the following electrical ratings as a minimum:

1. Two Level Terminal Blocks

a. Rated Voltage - 300V AC/DC.

b. Rated Current - 20 amp.

c. Wire Size Range - 30-12 AWG.

d. Three Level Terminal Blocks

1) Rated Voltage - 300V AC/DC.

2) Rated Current - 10 amp.

3) Wire Size Range - 26-14 AWG.

e. Terminal blocks shall be Allen-Bradley Series 1492 or approved equal.

Q. The control panel shall be completely factory assembled, wired, configured and tested prior to being shipped to the project site.

2.2 VENTILATION ALARMING LIGHTS AND HORNS

A. Contractor to provide LED lights and audible sounder/horns as shown on the Contract Drawings to indicate a failure of a continuous ventilation system.

B. Lights and sounders/horns shall possess the following features:

1. One LED light with red colored lens and one LED light with green colored lens. Green light will be energized to indicate a ”go” condition and red light and sounder/horn will be energized for “no go” condition.

2. Lights and sounder/horn shall be energized by contact closure within the control panels.

3. Lights and sounder/horn shall operate on 120VAC power (from HVAC monitoring panel) by contact closures to each lights LED and sounder. Lights

and sounder/horns to be powered out of control panel. Provide necessary power supplies, control transformers, etc. as required to provide an overall complete/operable system.

4. Lights and sounder/horn shall be rated NEMA 4X minimum and shall be suitable for use as indicated/shown on the Contract Drawings.

5. Provide a dome guard to protect lights from physical damage.

6. Sounder/horn shall have a corrosion-resistant housing suitable for mounting outdoors.

7. Provide wall mounting appurtenances and back boxes for lights and sounder/horn as required. Refer to Section 26 0529 Hangers and Supports for Electrical Systems.

8. Each LED light and sounder/horn to be labeled/identified. Refer to Section 26 0553, Identification for Electrical Systems, for additional information.

9. Provide as 3-position vertical stack. First position (bottom) to be sounder, second positon (middle) to be green (go) LED, and third position (top) to be red (no-go) strobe LED.

10. Provide conduit adapter as necessary.

11. Provide indicator ring and legend plate kits as necessary.

12. Manufacturer

    a. Provide light/horn stack as Federal Signal Global Series Custom Configured Fixtures Model # G-MSC-3A-120-NN-LG-SR or approved equal.

    b. Provide conduit adapter as Federal Signal K231247 or approved equal.

2.3 SPARE PARTS

A. The following spare parts shall be provided:

1. 24VDC panel power supply of each type

2. Two surge protectors of each type

3. Five fuses of each type/size

4. Five pilot light bulbs of each type

5. One warning light of each type

6. One sounder/horn of each type

7. Five miniature circuit breakers of each type/size

PART 3 EXECUTION

3.1 INSTALLATION

A. When a change from normal power to emergency power occurs and vice versa all equipment to be restarted automatically. Final requirements to be coordinated with the owner and engineer. Provide as required.

B. Install equipment at locations indicated on the contract drawings.

C. Provide all necessary cable, conduits, and fittings as required to provide a fully operable system. All wiring external to control panels shall be in conduit. Refer to the raceway schedule on the Contract Drawings for additional information.

D. Installation to be in compliance with NFPA 820.

3.2 START-UP SERVICE

A. The Systems Integrator shall provide the services of a qualified service technician/engineer to perform the following service duties.

1. Provide a minimum of 1 days of on-site services to provide installation instruction to the Contractor on all aspects of equipment installation.

2. Provide a minimum of 1 day of on-site startup services to provide a final system calibration, programming, and testing after completion of equipment installations.

3. Contractor to correct any deficiencies observed prior to Owner instruction indicated below.

4. Provide a minimum of one 4-hour session at the job site(s) to provide instruction to facility personnel in the operation, proper maintenance, troubleshooting, and repair of the equipment.

5. Following completion of the above services, the supplier shall provide an affidavit to the owner, certifying that the system is installed and operating in accordance with the Contract Documents.

END OF SECTION

SECTION 26 0911 - GAS DETECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract Drawings and general provisions of contract, including General and Supplementary Conditions, Division 1 and all of Division 26 Specifications, apply to this section.

1.2 SUBMITTALS

A. Submit all product and system data.

B. Submit shop drawings and product data for all equipment covered in this specification including:

1. Complete assembly, schematic, and installation drawings.

2. Descriptive information on materials and equipment furnished.

3. Complete drawings and wiring diagrams.

4. Complete product data

5. Performance data.

6. Furnish O & M manuals.

7. Warranty information.

8. Point to point wiring diagrams

1.3 GENERAL REQUIREMENTS

A. It is a requirement of this specification that the elements of the system be provided by a single supplier. This supplier shall have total responsibility for the entire system performance and compatibility of this section.

B. For ease of identification, equipment tags for the various components of the gas monitoring system to be furnished are depicted on the Contract Drawing Riser Diagrams and Floor Plans.

1. Provide labeling as called for on the Contract Drawings and as specified within section 26 0553.

C. Equipment to be UL listed.

1.4 SCOPE OF WORK

A. Provide and install a gas detection system complete with remote sensing devices, transmitter, displays, calibration equipment, alarm/horn stations, conduit & wire, control panel, and manufacturer's cable as follows and as shown/specified on the Contract Drawings:

    1. WWTP Headworks Building (4 sensor system with remote alarm light/horn stacks).

B. Refer to Contract Drawing Riser Diagrams and Floor Plans for device quantities, equipment tags, and additional information.

C. Sensors shall monitor for combustible gas (LEL), hydrogen sulfide (H2S), carbon monoxide (CO), and oxygen depletion (O2).

    1. Range of devices to be as follows:

        a. LEL: 0-100% LEL

        b. H2S: 0-50 PPM

        c. CO: 0-500 PPM

        d. O2: 0-25%

D. Provide as-built drawings upon completion of installation.

E. Provide two year full replacement warranty on all equipment as part of this specification section. Warranty shall replace, with new (not refurbished) equipment. Warranty duration shall commence on the date of substantial completion. Submit warranty informationg during submittal phase.

F. Provide commissioning servics, startup services, and training services.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. The gas detection systems shall be the following or approved equal:

    1. Combustible Gas Monitor with Remote Sensor - Mine Safety Appliances (MSA) Company, Part Number A-X5000-0M000AA000.

    2. Oxygen Depletion Monitor with Remote Sensor - Mine Safety Appliances (MSA) Company, Part Number A-X5000-0M00015000.

    3. Hydrogen Sulfide Monitor with Remote Sensor - Mine Safety Appliances (MSA) Company, Part Number A-X5000-0M00021000.

4. Carbon Monoxide Monitor with Remote Sensor - Mine Safety Appliances (MSA) Company, Part Number A-X5000-0M00011000.

B. Note for reference, a distributor of the above equipment is as follows:

1. Applied Measurement & Control

   1246 Commercial Drive, B01

   Farmington, NY 14425

   Phone: 585-398-7260

   sales@appliedmc.com

2.2 EQUIPMENT DESIGN

A. Combustible Gas Monitors

1. Combustible gas sensor shall employ infrared light technology. The sensor must have a demonstrated resistance to degradation by silicones and reduced sulfur gases (hydrogen sulfide).

2. Transmitter shall utilize one infrared light source that is directed through two different wavelength filters. One light beam shall be used as a reference and measure infrared light intensity outside of the hydrocarbon absorption range. The other infrared beam shall be the target gas beam and it shall traverse the gas diffusion volume in the signature wavelength of hydrocarbons. Each light beam shall be directed to its corresponding detector, and the difference in infrared light intensity shall be proportional to the target gas concentration. If no target gas is present, the difference between detectors shall be zero, and the transmitter shall output a zero gas reading.

3. Sensor shall not be susceptible to poisoning by background gases.

4. Transmitter shall utilize humidity and temperature compensation.

5. Sensor performance shall not be affected in low oxygen environments.

6. 316 stainless steel enclosure shall satisfy Class I, Division 1, Groups A, B, C, and D hazardous atmospheres.

B. Toxics and Oxygen Gas Monitors

1. Toxic gas sensors shall be the electrochemical type. The sensor must not require the periodic addition of reagents.

2. Oxygen depletion sensors shall be the electrochemical fuel cell type. The sensor must not require the periodic addition of reagents.

3. Gas measurement shall be temperature compensated.

4. Shall be a remote diffusion type, resistant to silicone poisoning and hydrogen sulfide poisoning.

5. 316 stainless steel enclosure shall satisfy Class I, Division 1, Groups A, B, C, and D hazardous atmospheres.

6. Each sensor shall have its own input output amplifier section.

C. All Gas Monitors

1. Integral Display

    a. Sensor/transmitters shall utilize an integral LCD display for calibration instructions and for 0 to 100 percent LEL, 0 to 50 ppm of H2S, 0 to 500 ppm of CO, or 0 to 25 percent oxygen level.

    b. Display shall have "unsuccessful calibration," "time to replace sensor," and "last successful calibration" indications.

    c. Display shall indicate error codes with logical English descriptions.

2. Each transmitter shall produce a directly proportional 4-20 mA output correlating to 0 value at 4 mA and 100 percent full value at 20 mA.

3. Transmitter shall enable user interaction with a hand-held wireless remote control that utilizes infrared light to communicate with the transmitter and facilitates sensor zeroing and calibration without opening the transmitter enclosure. Magnetic-type interaction with the transmitter is not acceptable.

4. 316 stainless steel enclosure with UL approved NPT conduit entries.

5. Dual condulet for mounting sensors remote from transmitter.

6. LEDs integral to transmitter to indicate status.

7. Calibrations shall be performed without opening the transmitter enclosure.

8. Sensor shall be capable of being remote mounted from the gas transmitter by up to 100 feet. Provide manufacturer factory cable for remote mounting the sensors as indicated on the Contract Drawings.

9. Transmitters to be powered from the gas monitoring control panel. Provide all necessary control panel internal power supplies in order to provide power to sensors/transmitters.

10. Performance Requirements

    a. Repeatability - Less than 2 percent full-scale for 0 to 100 percent LEL.

    b. Operating Temperature - -4 to 122 degrees F.

    c. Operating Humidity - 0 to 95 percent non-condensing.

d. Stability - +3 percent full-scale per year.

e. Linearity - Less than +2 percent full-scale.

f. Response Time - Less than 30 seconds.

g. Operating Voltage - 24 VDC, 3-wire.

1) Transmitters to be powered out of proposed gas monitoring panel. Provide necessary DC power supplies, control transformers, etc. as required to provide an overall complete/operable system.

2.3 REMOTE GAS ALARMING LIGHTS AND HORN (STACK)

A. Provide LED lights and audible sounder/horn in quantities and locations shown on the Contract Drawings for indication of the status of combustible, oxygen, carbon monoxide, and hydrogen sulfide gases. Lights and sounders shall possess the following features:

1. One LED light with red colored lens and one LED light with green colored. Green light will be energized to indicate ”go” condition and red light and sounder/horn will be energized for “no go” condition.

2. Lights and sounder/horn shall be energized by separate contact closure (from gas monitoring control panel).

3. Lights and sounder/horn shall operate on 120VAC power (from gas monitoring panel) by contact closures to each lights LED and sounder. Lights and sounder/horns to be powered out of control panel. Provide necessary power supplies, control transformers, etc. as required to provide an overall complete/operable system.

4. Lights and sounder/horn shall be rated NEMA 7 and shall be suitable for use in outdoor areas and also within Class, I Div. 1, Group D Hazardous areas where indicated on the Contract Drawings.

5. Provide a dome guard to protect lights from physical damage.

6. Sounder/horn shall have a corrosion-resistant housing suitable for mounting outdoors.

7. Provide wall mounting appurtenances for lights and sounder.

8. Provide a placard label for all devices indicating device.

9. Provide as 3-position vertical stack. First position (bottom) to be sounder, second positon (middle) to be green (go) LED, and third position (top) to be red (no-go) strobe LED.

10. Provide conduit adapter as necessary.

11. Provide indicator ring and legend plate kits as necessary.

12. Manufacturer:

    a. Provide light/horn stack as Federal Signal Global Series Custom Configured Fixtures Model # G-MSC-3A-120-NN-LG-SR or approved equal.

    b. Provide conduit adapter as Federal Signal K231247 or approved equal.

2.4 REMOTE GAS MONITORING PANEL

A. Provide a gas monitoring control panel for each specified system as shown on the contract drawings.

B. Gas monitoring panel shall include internal power supplies and relays for each sensor/transmitter wired to the enclosure as required to energize the alarm light and sounder circuits shown on the Contract Drawings.

C. Provide power supply sized as required to provide power to all transmitters, horns, and lights. Provide sizing calculations with submittal documentation for review/approval.

    1. Contractor to provide seperate enclosure for power supplies and terminal strips as required. Contractor required to provide necessary power to all devices and equipment for a complete and operable system.

D. Enclosure:

    1. Enclosure – NEMA 4X with rubber gasketed conduit penetrations.

E. For the remote gas monitoring panel, provide a power supply and one relay for each gas being monitored.

    1. Configure the normally open relay outputs to energize upon a hazardous gas condition. The relays shall energize the alarm indicating lights and sounder as shown on the Contract Drawings.

    2. Provide terminal blocks to land analog signals from each transmitter. In addition, provide terminal blocks to land light and horn wiring.

    3. Remote gas monitoring panel to output a common fault signal to the associated control panel as shown on the Contract Drawings. Provide dry contact within panel for relaying the common fault signal. Output shall be triggered upon a hazardous condition being met of any of the monitored gases.

    4. Remote gas monitoring panel to provide analog output from each transmitter.

    5. Provide terminals blocks to land discrete failure signals from each transmitter.

6. Provide a silence pushbutton on the face of the remote monitoring panel. Upon pressing the silence pushbutton, the sounder shall be de-energized.

7. Provide pilot lights for each gas transmitter wired to the remote gas monitoring panel. The light shall energize when the relay from the respective transmitter is active.

8. Provide nameplate for the remote gas monitoring panel. Nameplate to read "Gas Monitoring Panel".

F. Contractor to provide required interposing relays to connect multiple horns/strobes. Contractor to provide one 8-hour day on-site meeting with the owner/engineer to discuss/finalize sequence of operation and finalize operational intent. As a result of this meeting final interposing relay requirements will be provided.

G. Mount panel in location shown on the Contract Drawings with epoxy grouted, stainless steel bolts.

H. Enclosures shall be in accordance with applicable codes, federal laws, state laws, and be UL listed. All wiring in accordance with the latest revision of the NEC and NFPA.

I. The control panel shall be completely factory assembled, wired, configured, and tested prior to being shipped to the project site.

2.5 WIRING

A. All circuitry (conduit & conductors) as shown/specified on the Contract Drawings shall be included for an overall complete and operable system. Refer to Riser Diagrams on Contract Drawings for circuitry specifications.

2.6 ACCESSORIES

A. Nameplates - Provide rigid, laminated name tags with 5/16-inch high white letters on black background. Each monitor shall have nametags for the monitor designation and the designations for each of the sensors it monitors. Each alarm light shall have a nameplate indicating its intent.

B. Mount transmitter and sensor with equipment materials suitable for the mounting locations.

C. Calibration Kit - Provide four canisters of gas as required to calibrate all supplied transmitters/sensors, a gas regulator, and any other equipment needed for calibration in an insulated, hard plastic, impact resistant carrying case. Case interior shall be padded to protect contents. Calibration Kit shall be Mine Safety Appliances (MSA) Company, Part Number A-CAL 40F-10028032-00-0-10028062.

1. First Gas Canister - MSA model #: 10028032 which includes 2.5 percent methane (CH4) in air.

2. Second Gas Canister - MSA model #: 10028062 which includes 40 PPM hydrogen sulfide (H2S) in nitrogen.

3. Third Gas Canister - MSA model #: 10028028 which includes 20.80 percent oxygen (O2) in nitrogen.

4. Fourth Gas Canister - MSA model #: 10028048 which includes 400 PPM carbon monoxide (CO) in air.

5. Regulator to maintain manufacturer's recommended flow rate or 1.5 LPM.

D. Hand-held Programming Unit - Provide one hand-held wireless remote control that utilizes infrared light to communicate with the transmitter and facilitates sensor zeroing and calibration. Unit shall be MSA, Ultima Controller M/N: 809086.

E. Provide manufacturer-supplied cabling in continuous lengths as necessary to remotely mount the sensors from the transmitters as indicated on the Contract Drawings.

2.7 CONTROLS

A. All equipment specified in this section shall be electrically complete in that the Contractor is required to furnish and install only exterior power and signal wiring, conduits, fittings, etc. Labeled terminal strips shall be utilized throughout.

B. Contractor shall furnish sufficient length cables as required by the equipment manufacturer. Cables shall be installed in conduit by the Contractor.

C. Where required, alarm and warning setpoint gas concentrations shall be as follows and configured as such for the respective transmitters:

1. Combustible Gas - Warning 10.0 percent LEL; alarm 20.0 percent LEL.

2. Hydrogen Sulfide - Warning 10.0 ppm, alarm 15.0 ppm.

3. Oxygen Depletion - Warning 19.5 percent, alarm 18.0 percent.

4. Carbon Monoxide - Warning 10.0 ppm, alarm 30.0 ppm.

2.8 SPARE PARTS

A. The following spare parts shall be provided as part of this specification:

1. One (1) LEL sensor and transmitter

2. One (1) H2S sensor and transmitter

3. One (1) O2 sensor and transmitter

4. One (1) CO sensor and transmitter

5. Two (2) remote alarm light/horn stack

PART 3 – EXECUTION

3.1 INSTALLATION

A. Installation shall be in strict accordance with the respective instructions of the manufacturers in the locations shown on the Contract Drawings.

3.2 FIELD SERVICE

A. Calibrate sensors

B. Configure warning setpoints

C. Configure alarm setpoints

D. Configure the Transmitter to drive the analog output signal to 3.7 mA in the event of failed self-diagnostic tests.

E. Programming - Include 1 day for a manufacturer authorized service representative to meet on-site with the owner/engineer to discuss sequence of operation.

1. i.e, which lights/horns are to illuminate and when, etc..

F. Final Acceptance - Include 1 day for a manufacturer authorized service representative to test equipment to demonstrate that the system operates as specified.

G. Installation - Include 1 full day for a manufacturer authorized service representative to verify proper mounting of the equipment, including mounting technique, mounting surface, and functional location.

1. Provide MSA model # Z-COM-PREM-4 premium factory on-site commissioning services at the project site.

H. Training - Provide 1 full day of instruction to be conducted at the project site by the manufacturer. Notify the Engineer and Owner in writing a minimum of two weeks in advance. Duration of training is actual on-site training time with the operators; travel and other time shall be separate from this training requirement.

END OF SECTION

SECTION 26 0912 - CONTROL PANELS AND INTEGRATION

PART 1 GENERAL

1.1 DESCRIPTION:

A. All equipment, components, devices, instrumentation, etc... and associated integration services, programming, screen development, commissioning, startup, training, etc... included within this specification are to be furnished by the contractor thru the bid allowance. The contractor is to include all installation, mounting/hardware, wiring/circuitry (conduit & conductors), terminations, etc... of equipment, components, devices, and instrumentation specified herein within the base bid.

B. It is the intent that the Contractor will work with the system integrator specified herein to successfully fulfill the requirements specified herein and shown on the Contract Drawings to provide a complete and operable control system (fully integrated) with the intent specified and shown on the Contract Drawings.

1.2 SECTION INCLUDES

A. Control Building Main Control Panel (MCP)

B. MBR Building Remote I/O Panel (R I/O-1)

C. Dewatering Building Remote I/O Panel (R I/O-2)

D. Headworks Building Remote I/O Panel (R I/O-3)

E. ATAD Building Remote I/O Panel (R I/O-4)

F. Microscreen Building Remote I/O Panel (R I/O-5)

G. Chemical Fill Station Control Panels

    1. Typical of two (NaClO-FS-CP & NaOH-FS-CP)

H. Instrumentation

    1. Chemical Tank Radar Level Transmitters

    2. Capacitance Probes (Chemical Leak & Flood Detection)

    3. Open Channel Flow Meters

    4. DO Sensors & Controllers

    5. Submersible Level Transducers

    6. Float Switches

7. Temperature Sensors
8. Wet Floor Sensors
9. Combination Carbon Monoxide / Smoke Detectors

I. Chemical Leak Detection Horn / Strobes

J. SCADA Work Station Computer

K. Remote Access Windows Based Tablet

L. Hardware & Software

M. Alarm Dialer

N. Spare Parts

O. Existing Disinfection Building SCADA Panel (DBSP) Modifications

P. Integration Services, Programming, and Screen Development

Q. Commisioning, Startup Services, & Training

1.3 REFERENCE STANDARDS

A. All control systems as specified herein shall be provided in accordance with the latest additions of the NEC and IEC.

B. All wiring shall be in complete conformance with the National Electrical Code, State, local and NEMA electrical standards. All incoming and outgoing wires shall be connected to numbered terminal blocks and all wiring neatly tied and fastened to chassis as required.

C. All control panels shall be UL 508A listed. The UL 508A “sticker” shall be clearly displayed in the appropriate location within the panel. Third party substitutions of UL 508A listed equipment shall be strictly prohibited.

D. All equipment and installations shall satisfy applicable Federal, State, and local codes.

E. Furnish products listed and classified by Underwriters Laboratories (UL), CSA, or FM approval as suitable for purpose specified and indicated.

F. Auxiliary and accessory devices necessary for system operation or performance, such as transducers, relays, signal amplifiers, converters, intrinsic safety barriers, signal isolators, software, modules, or drivers to interface with existing equipment or equipment provided by others under other Sections of these specifications, shall be included whether they are shown on the Contract Drawings or not.

G. Use the equipment, instrument, and loop numbering scheme shown on the Contract Drawings and specifications in the development of the submittals. Do not deviate from or modify the numbering scheme without the Engineer's approval.

1.4 RELATED SECTIONS

A. Contractor to coordinate sequence of operation with the engineer, owner, and system integrator.

1. Contractor to include five (5) 8-hour meetings with the engineer, owner, and system integrator specified herein to discuss and finalize sequence of operation in which the control system is to be programmed for. Meetings to take place at the project site.

B. All Division 26 Specifications.

1.5 SUBMITTALS

A. The System Integrator shall for review, provide to the contractor, for submission to the engineer, one (1) electronic copy of the following documentation:

1. Written Sequence of Control System Operation (coordinate as required with the engineer and owner).

2. Electrical and Mechanical Schematic Drawings.

3. Bill of Materials.

4. Vendor Data Sheets.

5. System Warranty (see below).

6. Manufacturer's Certificate: The manufacturer shall submit a performance affidavit certifying to the Owner, Engineer, and the Contractor that the Contract Documents have been examined, and the equipment will meet the performance requirements set forth in the Contract Documents, for the application specified, in every aspect. The performance affidavit must be signed by an officer of the manufacturer and witnessed by a notary public. Shop drawings will not be reviewed prior to the receipt by the Engineer of an acceptable performance affidavit.

1.6 OPERATIONS AND MAINTENANCE DOCUMENTATION

A. The System Integrator shall provide to the contractor, one (1) hardcopy set and one (1) electronic copy (USB) of the following Operations and Maintenance documentation; all documentation shall be neatly bound in 3-ring binders.

1. Final Written sequence of control system operation (coordinate as required with the engineer and owner).

2. As-Installed Electrical and Mechanical Schematic Drawings including point-to-point wiring diagrams indicating as-built conditions.

3. Bill of Materials.

4. Vendor Data Sheets, Operation, Maintenance and troubleshooting documentation.

5. PLC and OIU program printouts.

6. Back-up Copies of As-installed PLC and OIU programs on CD and USB thumb drive.

1.7 WARRANTY

A. The Systems Integrator shall provide with the above submittals, a written parts warranty against system failure for twelve (12) months from system startup, not to exceed eighteen (18) months from date of shipment from their factory. This warranty period will, with the exception of human negligence or acts of nature such as lightning, floods, etc., provide for repair or replacement of any defective or failed components, at the project site, and at no cost to others.

    1. Warranty to include all equipment, hardware, devices, instruments, etc. that are specified as part of this specification.

1.8 QUALITY ASSURANCE

A. The Equipment, controls and accessories covered in this specification section constitute a completely integrated system, designed, constructed, programmed and tested by one System Integrator, accountable for its operation and performance. The System Integrator named hereafter has been chosen as the basis of design based on their ability to engineer, design and manufacture systems of the type herein specified. In addition, they possess a New York State based, factory trained, service staff experienced in routine and emergency service of the type of equipment herein specified.

B. The System Integrator shall be a reputable firm that has been in the business of providing automated control systems specifically for the water and wastewater treatment industry for a minimum of twenty (20) years.

C. The System Integrator shall have as a minimum, five (5) full time employees whom are experience in routine and emergency services of the equipment herein specified. The System Integrator shall as a minimum provide two (2) direct cell phone numbers in which service personnel can be reached 24hrs, 7 days a week.

D. The System Integrator shall be U.L. approved for manufacturing systems in compliance with UL 508A and/or UL 698A whichever may be applicable. Each assembly and subassembly of the system shall be listed and labeled as U.L. approved. System Integrators who outsource panel fabrication services for the purpose of providing UL labeling will not be accepted.

E. For serviceability reasons the system integrator’s service facility shall be located within 250 miles of the project site.

F. The basis of design for the equipment, controls and accessories covered in this specification section are based on utilizing equipment, software and knowledge from AquaLogics Systems, Inc., 5 Dwight Park Drive, Syracuse, NY 13209, contact Don Ballway at (315) 857-7696, or dballway@aqualogics.net. No other system integrator will be acceptable for Bid Allowance #1.

G. Control panels shall be fabricated with the following features as a minimum:

1. All sub panel wiring shall be run in plastic wire duct sized with 50% spare space, AC and DC wiring shall be run in separate wire ducts.

2. All power supplies shall be sized for an additional 50% spare ampacity over expected load. Each power supply shall include an AC input fuse and independent output fuses for each device requiring DC power.

3. All field terminations shall be made on compression type terminal blocks labeled according to wire number, separate terminal strips shall be provided for AC and DC signals. A minimum of 20% spare terminals shall be provided.

4. Wiring to door mounted components shall be neatly bundled wiring harnesses protected by plastic spiral wire wrap when crossing door hinge. Wiring harnesses shall have adequate stress loops and be fastened at both sides of hinge crossing.

5. All wiring shall be wire numbered at both ends with plastic Brady type labels.

6. All nameplates shall be engraved on lamacoid material providing black lettering on a white background. Lettering shall be no smaller than 1/8 of an inch in height.

7. Twenty percent spare mounting space is required for future modifications.

8. Control panels to be built with a minimum 10KAIC short circuit rating, or minimum rating as determined by the power system analysis specified within section 26 0573.

H. It is a requirement of this specification that all equipment, devices, instruments, and ancillary elements specified herein be furnished by a single system integrator. The system integrator shall have total responsibility for the equipment and services specified within this section.

1.9 ENVIRONMENTAL CONTROL OF PANELS

A. Panels shall be provided with louvers, sun shields, heat sinks, forced air ventilation, or air conditioning units as required to prevent temperature buildup inside of panel. Internal temperature of all panels shall be regulated to a range of 45 Deg F to 104 Deg F under all conditions. Under no circumstances shall panel cooling or heating equipment compromise the NEMA rating of the panel.

B. Except for panels mounted with their backs directly adjacent to a wall, louvers shall be in the rear of the panels, top and bottom, and shall be stamped sheet metal construction.

C. For panels mounted with their backs directly adjacent to a wall, louvers shall be on the sides.

D. Forced air ventilation fans, where used, shall provide a positive internal pressure within the panel, and shall be provided with washable or replaceable filters. Fan motors shall operate on 120-volt, 60-Hz power.

E. For panels with internal heat that cannot be adequately dissipated with natural convection and heat sinks, or forced air ventilation, an air conditioner shall be provided.

F. Provide custom fabricated sun shields for all outdoor panels in accordance with the following requirements:

1. Sun shields shall be fabricated from minimum 12 gauge Type 316 stainless steel. Units shall be designed, fabricated, installed, and supported to fully cover and shade the top, sides and back of the enclosure, and to partially shade the front panel of the enclosure, from direct exposure to sunlight from sunrise to sunset.

2. Depending on overall size, sun shields may be fabricated in single or multiple segments for attachment to the enclosure support framing or to separate free standing framing around the enclosure.

3. Sun shields shall not be attached directly to the enclosure by drilling holes through, or welding studs to, the enclosure surfaces, and shall be designed and mounted to provide a minimum 3-inch air gap all around the enclosure for air circulation and heat dissipation.

4. Top section of all sun shields shall be sloped at a minimum angle of 5 degrees from horizontal. For wall mounted enclosures, the top section shall slope downward away from the wall and towards the front of the enclosure. For free standing, floor mounted and frame mounted enclosures the top section shall slope downward towards the back side of the enclosure.

5. Front edge of the top section of all sun shields shall incorporate a narrow and more steeply sloped drip shield segment which sheds water away from the front of the enclosure and prevents it from dripping or running directly onto the front panel of the enclosure.

6. Seam welds used in sun shield fabrication shall be continuous and shall be ground smooth.

7. Exposed corners, edges, and projections shall be smooth rounded or chamfered to prevent injury

G. Outdoor enclosures and enclosures located in unheated areas indoors or in areas subject to humidity and moisture shall be provided with an integral heater, fan, and adjustable thermostat to reduce condensation and maintain the minimum internal panel temperature.

Mount unit near bottom of the enclosure with discharge away from heat-sensitive equipment. Heater shall be 120V, 60Hz, and sized per manufacturer/system integrators recommendations.

1.10 DESCRIPTION OF OPERATION

A. OVERVIEW

1. The System Integrator shall furnish (thru Bid Allowance) for contractor's installation the Control Panels and instrumentation specified herein, a SCADA work station computer, and remote access tablet for monitoring/control of the waste water treatment plant systems and processes. The control panels shall through communications and/or hardwired status and alarm signals monitor/control the operations of process equipment, vendor supplied equipment, and all equipment/devices pertinent to the operations of the waste water treatment plant systems.

2. The control system shall be provided with an Encrypted Ethernet Tunnel for remote system monitoring and control via an Internet connection. A windows based tablet with Encrypted Ethernet Tunnel client software shall be provided for operator remote access during off hours.

3. The control panels shall provide local alarm monitoring by door mounted alarm pilot lights, alarm horn, momentary pushbutton (for alarm acknowledgement, reset, and horn silence), and Operator Interface Unit (OIU).

4. The control panels and SCADA workstation located at the WWTP shall network via Ethernet communications over a fiber optic network (refer to the contract drawings). The MCP shall be provided with an Encrypted Ethernet Tunnel (VPN router) for secure Ethernet communications via the Internet to the remote access tablet computer.

5. Refer to the Contract Drawings for intent and all equipment/components that control panels are to interface with.

6. Refer to the Contract Drawings for wiring diagrams, Input/Output (I/O) type, quantity, schedule, and additional information/requirements.

7. Provide all hardware, software, programming, and screen development to provide all completely factory assembled and programmed control panels as indicated on the contract drawings and specified within.

8. System integration, programming, screen development, commissioning, startup, and training services are to be provided as part of this contract/specification thru bid allowance #1.

9. Contractor and Systems Integrator to provide five (5) 8-hour meetings with the owner/engineer at the project site to discuss control panel programming, sequence of operation, screen development, and overall intent to ensure specified control panels are programmed properly.

a. Coordinate meetings with owner/engineer two weeks in advance and prior to submittal documentation submission.

b. The below outline is general in nature and provides general intent. All control panel operational strategy to be finalized during the above specified meetings with the owner/engineer.

B. Sequence of Operation (Influent Pump Station)

1. All control strategies to be fully coordinated with the owner and engineer. Refer to the above required meetings to review sequence and finalize programming requirements.

a. Wetwell Level Monitoring:

1) A submersible level transducer shall be provided for installation within the influent pump station wetwells (typical of two). The transducer shall provide a 4-20 mAdc signal linear and proportional to wetwell level. The control panels shall utilize this signal for control, monitoring, trending and alarm functions.

(a) Two (2) submersible level transducers are to be provided. One in each chamber of the wetwell. Refer to article below for submersible level transducer specifications.

2) Float switches shall be provided for redundant high and low level alarm notification. The float switches shall be fail safe with the high level float switch being normally-closed, open on alarm. Refer to article below for float switch specifications.

(a) Two (2) float switches are to be provided per wetwell (total of four). Refer to article below for float switch specifications.

b. Wetwell Level Control.

1) As level in the wetwell rises above an adjustable Lead Pump "ON" setpoint, system logic shall start the lead pump by use of an associated VFD. The VFD shall ramp up in speed as required to control the wetwell level to the desired level setpoint. The wetwell level setpoint shall be fully adjustable via the control panel door mounted Operator Interface Unit (OIU).

2) Should wetwell level continue to increase while the lead pump is operating, system logic shall ramp the lead pump VFD speed up to maintain the desired level setpoint. Should influent flow (wetwell level) exceed the capacity of the lead pump, system logic shall automatically stage on the lag pump after the lead pump has been operating at its maximum speed for a programmable time delay. Once running, the lag pump VFD shall ramp up in speed to match that of the lead pump. System logic shall then control the speed of

both pumps simultaneously as required to control wetwell level to the desired level setpoint. The lead pump maximum speed and time delay setpoints for staging on the lag pump shall be fully adjustable via the control panel door mounted OIU.

3) Should the wetwell level decrease while both pumps are operating, system logic shall ramp both pump VFD speeds down simultaneously as required to control the wetwell level to the desired setpoint. Should the wetwell level decrease to a point that both pumps are operating at their minimum speeds for a programmable time delay system logic shall shutdown the lag pump. The lead pump speed shall then be controlled as required to control the wetwell level to the desired setpoint. The minimum speed and time delay setpoints for staging off the lag pump shall be fully adjustable via the control panel door mounted OIU.

4) The lead pump shall continue to operate, controlling the wetwell level to the desired setpoint, should wetwell flow decrease to a point that system logic ramps the lead pump VFD down to its minimum speed (programmed in the VFD) and wetwell level continues to drop below the Lead Pump “OFF” setpoint, system logic shall shut down the lead pump. The lead pump shall remain off until wetwell level once again rises above the Lead Pump “ON” setpoint initiating the next pump down cycle. The minimum speed, wet well level, and time delay setpoints for staging off the lead pump shall be fully adjustable via the control panel door mounted OIU.

   (a) Note, the Influent Pump Station includes three (3) pumps. Two of these pumps shall operate in a lead/lag configuration with the remaining pump serving as a standby. At no time shall all three pumps operate simultaneously. Provide necessary interlocks as required. Standby pump shall only operate in the event of a lead, or lag pump failure.

5) Operator adjustable high and low level alarm setpoints shall be provided for alarm annunciation of an abnormally high, or low wetwell level condition. Alarm setpoints and associated time delays for high and low level alarms shall be fully adjustable via the control panel door mounted OIU. All level alarms shall be annunciated on the control panel door mounted OIU, common alarm light, and alarm horn.

6) Operator adjustable pump maximum and minimum speed setpoints shall be full adjustable via the control panel door mounted OIU.

c. Level Control Selection:

1) Given there are two (2) level transducers located within the wetwell area, the selection of which level instrument is to be used as the "primary" level control instrument for control of the influent

pumping system is to be done virtually thru the control panel door mounted OIU (wetwell #1 - wetwell #2).

d. Hand-Off-Auto Pump Operation:

1) Pump operational mode shall be provided for each pump virtually thru the control panel door mounted OIU. Typical of each pump. Each mode shall operate as follows:

(a) Hand: When “Hand” mode is selected the respective pump shall start regardless of programmed system logic, pump speed shall then be adjustable via the VFD keypad.

(b) Auto: When “Auto” mode is selected the respective pump shall operate as required by programmed system logic.

(c) Off: When in “Off” mode the respective pump shall be prohibited from operation, system logic shall render the pump unavailable for operation.

(d) The control panel shall interface with the associated VFDs (external to the control panel).

e. Pump Alteration and Sequence Selection:

1) Pump Alternation and sequence selection (1-2-3 / 1-3-2 / 2-1-3 / 2-3-1 / 3-2-1 / 3-1-2 / Auto) shall be provided by the control panel door mounted operator Interface Unit (OIU).

(a) Selection 1-2-3: Pump 1 remains lead, pump 2 remains lag, and pump 3 remains standby on each pump down cycle, alternation of pump(s) only occurs in the event of a pump not being available for operation.

(b) Selection 1-3-2: Pump 1 remains lead, pump 3 remains lag, and pump 2 remains standby on each pump down cycle, alternation of pump(s) only occurs in the event of a pump not being available for operation.

(c) Selection 2-1-3: Pump 2 remains lead, pump 1 remains lag, and pump 3 remains standby on each pump down cycle, alternation of pump(s) only occurs in the event of a pump not being available for operation.

(d) Selection 2-3-1: Pump 2 remains lead, pump 3 remains lag, and pump 1 remains standby on each pump down cycle, alternation of pump(s) only occurs in the event of a pump not being available for operation.

(e) Selection 3-2-1: Pump 3 remains lead, pump 2 remains lag, and pump 1 remains standby on each pump down cycle, alternation

of pump(s) only occurs in the event of a pump not being available for operation.

(f) Selection 3-1-2: Pump 3 remains lead, pump 1 remains lag, and pump 2 remains standby on each pump down cycle, alternation of pump(s) only occurs in the event of a pump not being available for operation.

(g) Selection Auto: Lead Pump determined by system logic (runtime), alternation between pumps on each pump down cycle or upon the lead pump not being available for operation.

f. Pump Motor Winding Temperature Monitoring:

1) Each pump is equipped with high motor winding temperature switches. The control panel shall monitor these elements via discrete PLC inputs.

2) In the event of a motor winding temperature alarm, system logic shall shutdown the respective pump and render it unavailable for operation.

3) All motor high temperature alarms shall be annunciated on the control panel door mounted OIU, common alarm light and alarm horn.

g. Pump Availability:

1) A pump shall be considered unavailable for operation when any of the following conditions occur:

(a) Respective pump mode of operation selector switch is in the "OFF" position.

(b) Respective pump fails to start and/or VFD failure.

(c) Wetwell low-level condition

(d) Programmable system logic setpoints.

(e) Motor overtemperature condition.

h. System Alarm Annunciation:

1) All System alarms to be coordinated with the owner/engineer and shall be annunciated via common alarm light and alarm horn on control panel door mounted OIU.

2) Alarm acknowledgement, reset and horn silence shall be provided by a door mounted momentary pushbutton.

C. Refer to Contract Drawings for additional equipment that the control panels are to interface with for control/monitoring purposes and for an I/O Table indicating type and quantity of signals. Coordinate final requirements including alarming requirements closely with engineer and the owner.

PART 2 PRODUCTS

2.1 MAIN CONTROL PANEL & REMOTE I/O PANELS

A. The control panels shall be housed in a floor mount, single access, dual door, NEMA 12 enclosure constructed of 0.104” carbon steel with white polyester powder paint inside, ANSI 61 gray polyester powder paint outside. The enclosure shall have a 3-point latching system with zinc die cast key locking/padlocking handle. The enclosure shall have removable 12” floor stands, print pocket and door activated LED enclosure light. The enclosure shall be approximately 60" high by 60" wide by 16" deep. Dimensions provided are basis of design. Contractor to provide enclosure to house the hardware specified and meet the intent of the specification herein. The enclosure shall be Saginaw model SCE-606016LP or approved equal.

1. Control Panel to be provided with a fan/filter and thermostat kit per manufacturers recommendations.

2. Provide door with gasket system.

3. Door Interlock - Furnish mechanical means to prevent opening of cabinet with power connected, or to disconnect power if door is opened; include means for defeating interlock by qualified persons.

B. Control panel shall be UL 508A listed. The UL 508A “sticker” shall be clearly displayed in the appropriate location within the panel. Third party substitutions of UL 508A listed equipment shall be strictly prohibited.

C. Panel Input power shall be 120VAC, 1 Phase, 60Hz. Provide a sufficiently sized main circuit breaker disconnecting means. Interlock main circuit breaker disconnect with the control panel door handle.

D. Refer to Contract Drawings for additional information/requirements.

E. A 120VAC single phase surge protector shall be provided for the incoming 120VAC supply. The surge protector shall be designed to protect electrical and electronic equipment against transients caused by lightning, induction, load switching, EMP and other sources. Line to neutral, line to ground and neutral to ground protection shall be provided. The surge protector shall have a protection level of 1kV and a maximum discharge current of 140 kA as a minimum. The surge protector shall have a remote signaling device for fault indication to the PLC. The AC surge protector shall be CITEL model DS72RS-120 or approved equal.

F. All communication cabling that exits the building shall have surge protection provided.

G. Short circuit protection of 120VAC input and UPS control power shall be provided by a miniature branch rated circuit breaker with an interruptive capacity of 10K amperes at 240VAC. Circuit Breakers shall be Allen-Bradley 1489 series or approved equal

H. One print pocket shall be provided on the control panel door. One complete set of electrical control drawings shall be provided in the pocket.

I. Separate circuit breaker disconnects for each load supplied from the control panel shall be provided. All branch circuits shall be short circuit protected.

J. The control panels shall be provided with an Uninterruptible Power Supply (UPS) for protection against power disturbances, noise and brownouts. The UPS shall be of the true online type with 120VAC/1000VA output. The UPS shall be Vertiv/Liebert model GXT5-1000LVRT2UXL or approved equal.

K. The control panels shall be provided with a Programmable Logic Controller (PLC). The PLC shall be factory programmed, tested and debugged to meet all application requirements of PCC-1. The PLC system shall consist of CPU, power supply and all required I/O modules. The PLC shall support up to three (3) I/O module banks with a maximum local I/O expansion capacity of 30 I/O modules. The CPU shall have a minimum of two (2) Ethernet/IP ports and one (1) USB port, the CPU shall have 3 MB of memory and support up to 48 Ethernet/IP nodes and 256 Ethernet/IP controller connections. The PLC system shall be Allen-Bradley CompactLogix 1769-L36ERM CPU with 1769-PA4 power supply and 1769 series I/O modules or approved equal.

L. The control panel shall be provided with a door mounted 15” color touchscreen Operator Interface Unit (OIU) shall be provided for system monitoring, control, setpoint entry/review and system alarm annunciation. The OIU shall be factory configured with application specific graphic screens as well as provide system trends and data logging as required. The 15” diagonal screen shall have a minimum resolution of 1024 x 768, 18-bit color graphics, the OIU operating system shall be Microsoft Windows CE and support Virtual Network Connections (VNC). The OIU shall have a memory capacity of 512 MB RAM/512 MB nonvolatile. External storage shall be provided by a Secure Digital (SD) card. The OIU shall have a battery backed real-time clock and have an enclosure rating of NEMA 12, 13, 4X, IP 66 as classified by UL. The Operator Interface Unit (OIU) shall be Allen-Bradley model 2711P-T15C22D9P or approved equal.

M. The control panels shall be provided with a fully managed 20-port industrial gigabit Ethernet switch with eight (8) 10/100/1000TX Ethernet ports and twelve (12) 100/1000 SFP slots for use with various media transceivers. The Ethernet switch shall be Antaira model LNX-2012GN-SFP or approved equal.

    1. To clarify, the communication link between the proposed remote I/O panels and the main control panel is to be by fiber optic cable. Control panels to be provided with necessary hardware/devices to terminate fiber optic cable and convert to copper for use within the specified control system. Refer to the contract drawings for additional information.

N. The control panels shall be provided with an Industrial VPN router for secure remote access to the control system via the Internet (Main Control Panel Only). The VPN router

shall allow for remote access via computer, tablets and/or smart phones. The VPN shall have a minimum of five (5) GB Ethernet ports (4x LAN, 1x WAN) and shall be CE, cULus, RoHS and REACH certified. The router shall be Automation Direct StrideLinx model SE-SL3011 or approved equal.

O. Control panel shall be provided with a DC power supply: a 24V direct current power supply shall be provided to power the PLC, OIU, I/O, and all ancillary equipment. The power supply shall have an operational input range of 85 to 132VAC and shall have a minimum rated output of 24 to 28VDC/240 watts. Power supply shall be PULS QS10.241 or approved equal.

P. The control panel shall provide visual alarm annunciation via common alarm pilot light and OIU alarm screen. Pilot light shall be 30mm, industrial grade, push-to-test type, Allen-Bradley 800T series or approved equal.

Q. The control panel shall provide audible alarm annunciation via alarm horn. Alarm horn shall provide a typical sound pressure of 95 + 5 dB(A) at 30VDC, at 24 inches and shall have a built-in volume control providing variable attenuation up to 20 dB(A). The alarm horn shall be Floyd Bell model MC-V09-530-Q or approved equal.

R. A momentary pushbutton shall be provided for alarm acknowledgment/reset and alarm horn silence, pushbutton shall be 30mm industrial grade, Allen-Bradley 800T series or approved equal.

S. Control panel shall have a single tube, LED light fixture, 10 Watt in size, mounted internally to the ceiling of the panel. Light fixture shall be switched and shall be complete with the lamp.

T. Control panel shall have a specification grade duplex convenience receptacle with ground fault interrupter, mounted internally within a stamped steel device box with appropriate cover. Convenience receptacle shall not be powered from a UPS and shall be protected by a dedicated fuse or circuit breaker.

U. AC power fuses shall be provided as required for over current protection of individual AC powered panel components. Single circuit fusible terminal blocks with neon blown fuse indicators suitable for use with ¼" x 1 ¼" glass fuses shall be provided for each circuit requiring fuse protection. Fusible terminal strips shall have a working voltage rating of 100 to 300VAC, and have a current rating of 12 Amps, fuse blocks shall be Allen-Bradley model 1492-H4 or approved equal.

V. DC power fuses shall be provided as required for over current protection of individual DC powered panel components. Single circuit fusible terminal blocks with LED blown fuse indicators suitable for use with ¼" x 1 ¼" glass fuses shall be provided for each circuit requiring fuse protection. Fusible terminal strips shall have a working voltage rating of 10 to 57V AC/DC, and have a current rating of 12 Amps, fuse blocks shall be Allen-Bradley model 1492-H5 or approved equal.

W. Interposing and control relays shall be provided as required. They shall be of industrial grade, plug-in socket type, and shall have 24VDC or 120VAC coils and 2PDT or 4PDT form C relays as required. All relay contacts shall be silver nickel plated, 2PDT relay contacts shall be rated for 10A at 300VAC and 4PDT relay contacts shall be rated for 7A

at 300VAC. All relays shall be provided with a standard ON/OFF flag indicator, mounting base and retainer clip. Control relays shall be Allen-Bradley series 700-HC or approved equal.

X. Compression type terminal blocks shall be provided for all field connections, wiring field equipment directly to PLC I/O bases or other panel components is not acceptable. Terminal blocks shall have the following electrical ratings as a minimum:

    1. Two Level Terminal Blocks

        a. Rated Voltage: 300V AC/DC

        b. Rated Current: 20 Amp

        c. Wire Size Range: 30-12 AWG

    2. Three Level Terminal Blocks

        a. Rated Voltage: 300V AC/DC

        b. Rated Current: 10 Amp

        c. Wire Size Range: 26-14 AWG

    3. Terminal blocks shall be Allen-Bradley series 1492 or approved equal.

    4. All circuitry to be landed on labeled terminal blocks.

Y. The control panel shall be provided with a remotely mounted and wired telephone alarm dialer for remote annunciation of system alarms (mount adjacent to the Main Control Panel). The dialer shall have as a minimum the following features:

    1. The dialer enclosure shall be NEMA 1, with integral LED display and keypad.

    2. The dialer shall include an integral battery and associated charger to provide 20-hour operation during power outages. All of the dialer's inputs including power supply, telephone line and alarm inputs shall be individually surge protected. The dialer shall be capable of synthesizing the operator's own voice messages and will be capable of monitoring sixteen (16) discrete inputs plus 120VAC power source. The dialer shall be capable of calling up to sixteen (16) phone numbers, independently programmable to any or all of the alarms.

    3. Programmable functions such as independent time delay before call out, time between consecutive calls and alarm input sense that is normally open or normally closed, shall be inherent.

    4. All voice messages and functions will be programmable locally via the dialer's integral keypad or remotely via telephone communications. Security codes (up to 8 digits) shall be programmable to prevent unauthorized access to the dialer's configuration.

5. The alarm dialer shall be modular in design, allowing future expansion of discrete input channels, analog input channels, and remote supervisory control outputs.

6. The alarm dialer shall have a five (5) year parts and labor warranty.

7. Provide expansion card as required to monitor 16 inputs.

8. Coordinate with the owner for which alarms/signals are to be incorporated in the proposed autodialer. Contractor to program the dialer as required.

9. The alarm dialer shall be RACO model VSS-16C or approved equal.

Z. 24VDC signal line surge protectors shall be provided for all analog signals that exit the building or otherwise run outdoors. The surge protectors shall have a removable surge protection element, allowing for the surge protector to be removed from its base without disturbing the signal wiring. There shall be no interruption of signal when the surge protection element is removed. The surge protectors shall be M-Systems model MDP-24-1 or approved equal.

AA. All Ethernet communications cabling exiting the building shall be protected by a signal line surge protector for protection against electrical surges caused by lightning and other sources. Each surge protector shall have the following features as a minimum:

1. Application: Ethernet CAT6

2. Maximum Data Rate: 1000 Mbps

3. Maximum DC Signal: 7.5VDC, 1A

4. Maximum Discharge Currents:

    a. Line to Line: < 132A at 10/1000 ?s

    b. Line to Ground (each line): 132A at 10/1000 ?s

5. Connections: Input/Output RJ45

6. Pinout: Four (4) pairs and a ground

7. Standard Compliance: IEC 61643-21 (surge withstand)

8. Ethernet network surge protectors shall be CITEL MJ8-CAT6 or approved equal.

AB. Varistor type surge protection terminal blocks shall be provided for all discrete signals that exit the building or otherwise run outdoors. Surge protection terminal blocks shall be rated for 120VAC or 24VDC as required by signal type. The surge protector terminal blocks shall be Phoenix Contact model 2794903 (DC circuits), model 2794987(AC circuits) or approved equal.

AC. Control panels shall be provided with aneroid bellows for terminating the level transmitter vent tube, protecting the transmitter from damage due to moisture.

AD. Control panels to be provided with a 6-pair fiber optic patch panel within a NEMA 1 enclosure. Patch panel to accept incoming fiber optic cabling. Fiber optic patch panel enclosure to be item # FE-WM12PP as manufactured by L-com or approved equal. Fiber optic patch panel to be item # FSP-LCD6-BR as manufactured by L-com or approved equal.

AE. The control panel shall be completely factory assembled, wired, configured and tested prior to being shipped to the project site.

1. The Engineer shall have the right to witness the factory tests and inspect any equipment to be furnished under this Section prior to their shipment from place of manufacture.

2.2 CHEMICAL FILL STATION CONTROL PANELS

A. The control panels shall be housed in NEMA 4X stainless steel, lockable, wall mount enclosures rated for outdoor use. The enclosures shall be approximately 24" high by 24" wide by 12" deep (or as required to house equipment specified herein and perform intended operations). The enclosures shall be Hoffman, Saginaw, or approved equal.

1. Outdoor enclosures and enclosures located in unheated areas indoors or in areas subject to humidity and moisture shall be provided with an integral heater, fan, and adjustable thermostat to reduce condensation and maintain the minimum internal panel temperature. Mount unit near bottom of the enclosure with discharge away from heat-sensitive equipment. Heater shall be 120V, 60Hz, and sized per manufacturer/system integrators recommendations.

B. Control panel shall be UL 508A listed. The UL 508A “sticker” shall be clearly displayed in the appropriate location within the panel. Third party substitutions of UL 508A listed equipment shall be strictly prohibited.

C. Panel Input power shall be 120VAC, 1 Phase, 60Hz. Provide a sufficiently sized main circuit breaker disconnecting means. Interlock main circuit breaker disconnect with the control panel door handle.

D. Refer to Contract Drawings for additional requirements.

E. A 120VAC single phase surge protector shall be provided for the incoming 120VAC supply. The surge protector shall be designed to protect electrical and electronic equipment against transients caused by lightning, induction, load switching, EMP and other sources. Line to neutral, line to ground and neutral to ground protection shall be provided. The surge protector shall have a protection level of 1kV and a maximum discharge current of 140 kA as a minimum. The surge protector shall have a remote signaling device for fault indication to the PLC. The AC surge protector shall be CITEL model DS72RS-120 or approved equal.

F. Short circuit protection of 120VAC input power shall be provided by a miniature branch rated circuit breaker with an interruptive capacity of 10K amperes at 240VAC. Circuit Breakers shall be Allen-Bradley 1489 series or approved equal

G. One print pocket shall be provided on the control panel door. One complete set of electrical control drawings shall be provided in the pocket.

H. The control panel shall be provided with a door mounted digital tank level display for each chemical tank (typical of 2) to monitor tank level. Digital display to be as manufactured by Red Lion or approved equal.

I. The control panel shall be provided with door mounted 90% full (amber) and high level alarm (red) LED pilot lights for each tank. Pilot lights shall be 30mm, industrial grade, push-to-test type, Allen-Bradley 800T series or approved equal.

J. The control panel shall provide audible alarm annunciation via alarm horn. Alarm horn shall provide a typical sound pressure of 95 + 5 dB(A) at 30VDC, at 24 inches and shall have a built-in volume control providing variable attenuation up to 20 dB(A). The alarm horn shall be Floyd Bell model MC-V09-530-Q or approved equal.

K. A momentary pushbutton shall be provided for alarm acknowledgment/reset and alarm horn silence, pushbutton shall be 30mm industrial grade, Allen-Bradley 800T series or approved equal.

L. AC power fuses shall be provided as required for over current protection of individual AC powered panel components. Single circuit fusible terminal blocks with neon blown fuse indicators suitable for use with ¼" x 1 ¼" glass fuses shall be provided for each circuit requiring fuse protection. Fusible terminal strips shall have a working voltage rating of 100 to 300VAC, and have a current rating of 12 Amps, fuse blocks shall be Allen-Bradley model 1492-H4 or approved equal.

M. Compression type terminal blocks shall be provided for all field connections, wiring field equipment directly to PLC I/O bases or other panel components is not acceptable. Terminal blocks shall have the following electrical ratings as a minimum:

1. Two Level Terminal Blocks

    a. Rated Voltage: 300V AC/DC

    b. Rated Current: 20 Amp

    c. Wire Size Range: 30-12 AWG

2. Three Level Terminal Blocks

    a. Rated Voltage: 300V AC/DC

    b. Rated Current: 10 Amp

    c. Wire Size Range: 26-14 AWG

3. Terminal blocks shall be Allen-Bradley series 1492 or approved equal.

4. All circuitry to be landed on labeled terminal blocks.

N. The control panel shall be completely factory assembled, wired, configured and tested prior to being shipped to the project site.

1. The Engineer shall have the right to witness the factory tests and inspect any equipment to be furnished under this Section prior to their shipment from place of manufacture.

2.3 INSTRUMENTATION

A. RADAR LEVEL TRANSMITTERS

1. Radar level transmitters shall be provided for installation at the following locations (typical of five), and shall provide a 4-20 mAdc signal linear and proportional to chemical tank level. The control panels shall utilize this signal for control, monitoring, trending and alarm functions.

a. NaOH Day Tank Level (15-LIT-301)

b. NaOH Bulk Storage Tank No.1 Level (15-LIT-302)

c. NaOH Bulk Storage Tank No.2 Level (15-LIT-303)

d. NaClO Day Tank Level (23-LIT-101)

e. NaClO Bulk Storage Tank Level (23-LIT-102)

2. General

a. The level transmitters shall be suitable both for measuring liquids and for use on small bulk solids silos or bulk solids containers.

b. The level transmitters shall emit a continuous radar signal through the antenna. The emitted signal is reflected by the medium and received as an echo by the antenna.

c. The frequency difference between the emitted and received signal is proportional to the distance and depends on the filling height. The determined filling height is converted into a respective output signal and output as measured value.

d. The transmitters shall provide a 4-20 mAdc signal linear and proportional to measured level.

e. The transmitter shall have the following features as a minimum:

1) Measuring range: up to 15 m (49.21 ft)

2) Deviation/Accuracy: less than 2 mm

3) Beam angle: 8°

4) Measuring frequency: W-band (80 GHz technology)

5) Output signal: 4 … 20 mA/HART

6) Process fitting Thread: G1½, 1½ NPT, R1½

7) Process pressure: -1 … +3 bar (-100 … +300 kPa/- 14.5 … +43.51 psig)

8) Process temperature: -40 … +80 °C (-40 … +176 °F)

9) Bluetooth standard: Bluetooth 5.0

10) Bluetooth range: typically 25 m (82 ft)

11) Operating voltage: 12 … 35 V DC

12) Protection rating: IP66/IP67 acc. to IEC 60529, Type 4X acc. to UL 50

13) Explosion protection: Intrinsic Safety

f. Materials

1) Wetted parts: PVDF

2) Process seal: FKM

3) Housing PBT Plastic IP/66/IP67, Type 4X

g. Adjustment

1) PC, PACTware and DTM

2) Smartphone/Tablet/PC via Bluetooth

h. Indication

1) Display/adjustment module, 3-button.

i. Approvals

1) IEC / worldwide

2) CSA / USA and Canada

3) FDA

4) Drinking water

3. Accessories

    a. Provide stainless steel mounting bracket to facilitate mounting as shown on the contract drawings, and as field verified.

4. The Radar Level Transmitters shall be VEGAPULS 31 or approved equal.

B. CAPACITANCE PROBES (CHEMICAL LEAK & FLOOD DETECTION)

1. The capacitance probes shall be specifically designed for chemical applications.

2. The probes shall be supplied with factory cable. The cable shall be encased in a polyurethane jacketed shielded cable. The cable shall have a 200 lbs. pull strength and be of enough length to reach the associated transmitter in a continuous run without splices.

    a. Contractor to assume 100 linear feet of cable. Final cable length to be coordinated in the field.

3. The capacitance probe to be Pointek CLS200 as manufactured by Siemens or approved equal. Provide quantity of seventeen (17) at the following locations. Provide all necessary mounting brackets/hardware to install per manufacturers recommendations. All mounting brackets/hardware to be of stainless steel material. Capacitance probe shall provide a relay output signal for indication of a chemical leak (LDS-), or flood detection (FDS-). The control panels shall utilize this signal for control, monitoring, trending and alarm functions.

    a. Chemical Leak Detection Sensors (typical of four):

        1) NaClO Chemical Room (LDS-500)

        2) NaOH Chemical Room (LDS-501)

        3) NaOH Chemical Room (LDS-502)

        4) Chemical Skid Room (LDS-503)

    b. Flood Detection Sensors (typical of thirteen)

        1) Proposed Headworks Building (FDS-200)

        2) Existing Headworks Building (FDS-201)

        3) ADAD Building Thickening Room (FDS-400)

        4) ATAD Building Equipment Room (FDS-401)

        5) MBR Building RAS Pump Room (FDS-500)

        6) MBR Building Membrane Room (FDS-501)

        7) Microscreen Building (FDS-502)

8) Influent Pump Station Dry Well (FDS-503)

9) Dewatering Building Basement (FDS-700)

10) Dewatering Building Press Room (FDS-701)

11) Sludge Dry Well (FDS-800)

12) Existing Sludge Control Valve Vault (FDS-801)

13) Proposed Sludge Control Valve Vault (FDS-802)

C. OPEN CHANNEL FLOW METER

1. Open channel flow meters shall be provided for installation at the following locations (typical of four), and shall provide a 4-20 mAdc signal linear and proportional to flow. The control panels shall utilize this signal for control, monitoring, trending and alarm functions.

    a. Influent Channel Parshall Flume (UT-02)

    b. Backpulse Tank (UT-03)

    c. Effluent Channel (UT-04)

    d. Effluent Channel (UT-05)

2. General

    a. The Open Channel Flow Meters shall use a non-contacting ultrasonic sensor mounted over the effluent weir to measure flow. The flow meter shall have the following features as a minimum:

        1) Operating Parameters: Flume or weir to measure flow, or inside / above a tank to measure level.

        2) Programming: Built-in 5-key calibrator with English, French, or Spanish language selection.

        3) Electronics Enclosure: NEMA 4X (IP66) polycarbonate with clear, shatterproof cover.

        4) Accuracy: ±0.25% of measured range or 2 mm (0.08 in) whichever is greater, Repeatability and Linearity: ±0.1%.

        5) Display: White, backlit matrix — displays flow rate, totalizer, relay status, operating mode, and calibration menu.

        6) Power Input: 100-240 V AC 50/60 Hz

        7) Output: Isolated 4-20mA 0-5 V, 1 kohm load maximum.

8) Control Relays: 2 Relays, form 'C' dry contacts rated 5 A SPDT; programmable level alarm, pump control, pump alternation, failsafe/ echo-loss, air temperature alarm.

9) Data Logger: Built-in 26-million-point data logger with USB output and Windows software.

10) Operating Temperature (Electronics): -20 °C to 60 °C (-5 °F to 140 °F)

11) Approvals: CE, cCSAusogs.

3. Transducer

a. Maximum Range: 4.6 m (15 ft) with standard PZ15 sensor.

b. Operating Temperature: -15 °C to 80 °C (5 °F to 175 °F).

c. Deadband (Blanking): Programmable, Minimum 203.2 mm (8 in)

d. Beam Angle: 8°

e. Operating Frequency: PZ15: 92 kHz

f. Operating Temperature: -40 °C to 65 °C (40 °F to 150 °F) with automatic temperature compensation.

g. Submersion Rating: Protected for accidental submersion to 3 m (10 ft) maximum.

h. Sensor Cable: RG62AU coaxial, 7.6 m (25 ft) standard length

i. Sensor Hazardous Locations: Intrinsically safe for Class I, Div 1, Groups C, D; Class II, Groups E, F, G; Class III; Encl. Type 4.

4. Accessories

a. Provide stainless steel mounting bracket to facilitate mounting as shown on the contract drawings, and as field verified.

5. The Open Channel Flowmeter shall be Pulsar/Greyline OCF 6.1 with PZ15 sensor for Class I, Div 1 installations or approved equal.

D. DO SENSORS AND CONTROLLERS

1. Dissolved oxygen sensors shall be provided for installation at the following locations (typical of two), and shall provide a 4-20 mAdc signal linear and proportional to dissolved oxygen. The control panels shall utilize this signal for control, monitoring, trending and alarm functions. Two (2) dissolved oxygen sensors shall be wired to a single two-channel controller. The existing Disinfection Building SCADA Panel (DBSP) shall be reprogrammed and modified as required to accept these signals for controlling and monitoring the

two (2) post aeration blowers as shown and indicated on the contract drawings. Coordinate final control strategy, setpoints, and requirements with the owner / engineer during the coordination meetings specified above.

a. Post Aeration Tank Dissolved Oxygen Controller (DOC-01).

b. Post Aeration Tank No.1 Dissolved Oxygen Sensor (DOS-01).

c. Post Aeration Tank No.2 Dissolved Oxygen Sensor (DOS-02).

2. Dissolved Oxygen Probes:

a. The method of measuring the dissolved oxygen will be luminescent.

b. A Blue LED will flash at a platinum based luminescent material causing the material to become excited. When the blue LED is turned off the luminescent material relaxes and emits a red light that is measured at a photo detector. Oxygen acts as a quenching agent for the red light release. The time of the cycle is measured and is directly proportional to the amount of oxygen present. A red LED is also present that zeros the instrument between measuring cycles.

c. There is no membrane, electrolyte or electrodes used in this measurement.

d. Other methods of dissolved oxygen measurement such as galvanic, Polarographic or luminescent measurements using Ruthenium are not acceptable.

e. Performance Requirements:

1) Measurement range: 0.01 to 20.00 mg/L for dissolved oxygen.

2) Temperature: 0.0-50.0° C or 32.0-122.0° F.

f. Accuracy:

1) <5 PPM ±0.1 PPM.

2) >5 PPM ±0.2 PPM.

g. Repeatability: ± .01 PPM.

h. Response Time:

1) <40 seconds to 90% at 20°.

2) <60 seconds to 95% at 20°.

i. The Sensor shall be fully tested and have no interferences from the following:

1) H2S, pH, K+1, Na+1, Mg+2, Ca+2, NH4, +1, Al+3, Pb+2, Cd+2, Zn+2, Cr (tot), Fe+2, Fe+3, Mn+2, Cu+, Mi+2, Co+2, CN-1, NO3, -1, SO4-2, S-2, PO4+3, Cl-1, Anion Active Tensides, Crude Oils, Cl2-1.

j. Environmental Requirements:

1) Probe operating Temperature: 0 to 50 degrees C.

2) Sample pH range: 0.0 to 12.0.

3) Probe immersion depth: 112 maximum.

k. Approvals:

1) DO Probes shall be Class 1, Div. 2 approved.

l. Warranty:

1) The Probe body is warranted for 3 years from date of purchase.

2) The Sensor cap is warranted for 2 year from date of purchase.

m. Maintenance Service:

1) Scheduled maintenance: Occasional Wiping of sensor.

2) Unscheduled maintenance: Replacement of Sensor cap when system fails.

n. The submersible probe shall have a stainless steel protective sleeve and an integral 10 M cable (30ft).

o. The probe shall have a field replaceable sensor cap.

p. The probe shall continuously monitor dissolved oxygen content in aqueous solutions via luminescent technology using platinum based compounds.

q. The probe shall use no membranes, electrolyte or electrodes.

r. The probe shall have a built in temperature compensator.

s. The probe shall be factory calibrated and need no calibration or polarization prior to use.

t. Mounting Hardware:

1) Each probe shall be provided with a pn.9253000 pole mounting kit. The mounting hardware shall be the manufacturers' standard design or similar method for mounting the sensor vertically in the tank. All the components shall be 316 stainless steel and/or PVC.

2) Provide all miscellaneous fasteners, struts, and piping as required for proper installation of the sensor at the location indicated on the drawings. All miscellaneous items shall be constructed of PVC, aluminum, or stainless steel.

u. DO Probe Extension Cable:

1) Each probe shall be provided with a 100' extension cable, pn. 5796200.

3. Dissolved Oxygen Monitor/Controller:

a. The controller shall accept two inputs from Hach digital sensors.

b. Power Requirements: 100-240 VAC ±10%, 50/60 Hz; 1 A.

c. The controller shall have 3.5-inch TFT color display with capacitive touchpad.

d. The controller shall have Five (5) 0-20 mA or 4-20 mA analog outputs.

e. Operating Temperature Range:

1) -20 to 60 °C (-4 to 140 °F) (8 W (AC)/9 W (DC) sensor load).

2) -20 to 45 °C (-4 to 113 °F) (28 W (AC)/20 W (DC) sensor load).

3) Linear derating between 45 and 60 °C (-1.33 W/°C).

f. Storage Conditions: -20 - 70 °C (-4 - 158 °F), 0 - 95% relative humidity, non-condensing.

g. The controller shall have two electromechanical relays; SPDT (Form C) contacts; rated 5A, 240VAC.

h. The controller shall have non-volatile flash memory back-up.

i. Compliance Certifications:

1) CE. ETL certified to UL and CSA safety standards (with all sensor types), FCC, ISED, KC, RCM, EAC, UKCA, SABS, C (Morocco).

j. Construction:

1) Polycarbonate, aluminum (powder coated), stainless steel.

2) Conduit openings: ½" NPT Conduit.

k. The controller shall have Panel, surface, and pipe (horizontal and vertical) mounting configurations.

l. Controller Enclosure:

1) The controller shall be housed in a NEMA 4X fiberglass enclosure with a thermostatically controlled 100-watt heater, 120VAC input power circuit breaker, 120VAC input power surge protector and two (2) DO signal surge protectors. All components shall be factory installed and wired within the enclosure prior to shipment to the site. The assembly shall be provided with the following set of as-installed documentation: electrical schematic drawing, mechanical layout drawing, and bill of materials.

4. The Dissolved Oxygen monitoring systems shall be Hach LDO Probe Model 2 (Class 1 Div 2 rated) with 9253000 pole mounting kit, 5796200 sensor extension cable and SC4500 digital controller or approved equivalent.

E. SUBMERSIBLE LEVEL TRANSDUCERS

1. The submersible level transducers shall be specifically designed for wastewater service and be certified intrinsically safe for hazardous locations.

2. The transducers shall be non-fouling design incorporate a 4.10” PTFE isolated diaphragm with a 2.75” sensing area fitted to a rugged 316 stainless steel case.

3. Transducers to be chemically resistant and hermetically sealed.

4. The transducers shall be 2-wire (22 AWG) design and produce a 4-20 mAdc signal linear to wetwell level. The conductors shall be encased in a polyurethane jacketed shielded cable with a polyethylene vent tube and Kevlar tension members. The cable shall have a 200 lbs. pull strength and be of enough length to reach the control panel in a continuous run without splices. Contractor to assume 100 feet of cable. Final cable length to be coordinated in the field.

5. The transducers shall have a ½” MNPT conduit fitting to provide for mounting the transducer to a conduit or suspension kit.

6. The transducers shall carry a lifetime surge protection warranty which shall include a din rail mount 24VDC surge protector for installation in the control panel.

7. The level transmitters shall be provided with an aneroid bellows for transmitter vent tube termination. The bellows shall be mounted in the control panel.

8. The level transmitters shall be provided with a weighted suspension kit consisting of a 1” stainless steel pipe (a minimum of 40” long) which shall be attached to the transmitter conduit fitting. The suspension kit shall be provided with 40’ of 1/8” stainless steel cable and clamps to facilitate suspending the transmitter into the wetwell, while allowing it to be easily removed for service without entry into the wetwell.

9. The transducers range shall be suitable for the operating range of the wetwell. Contractor to field verify and coordinate with the owner.

10. The level transmitters shall be TE Connectivity/Measurement Specialties model 750 or approved equal. Provide two (2) submersible level transducers (one in each chamber of the wetwell) at the influent pump station.

F. FLOAT SWITCHES

1. Each float switch shall be of the direct acting type, containing a single pole non-mercury switch, which actuates when the longitudinal axis of the float is horizontal, and deactivates when the liquid level falls 1" below the actuation elevation.

2. Each float shall be housed in a chemical resistant polypropylene casing with a firmly bonded electrical cable protruding. One end of the cable shall be permanently connected to the enclosed switch with the entire assembly encapsulated to form a completely watertight and impact resistant unit, provide enough cable length as required by wetwell depth (as indicated on the contract drawings) to reach the control panel or junction box as indicated on the Contract Drawings.

    a. Contractor to assume 100 feet of cable. Final cable length to be coordinated in the field.

3. Float switches shall be suitable for low-current operation compatible with intrinsically safe barriers and/or PLC inputs.

4. A coated steel anchor assembly with stainless steel chain and float clamps shall be provided for installing the float switches within the wetwell area as indicated on the Contract Drawings. The anchor assembly shall allow for removal of floats without entering the wetwell.

5. Float switches shall be SJE Rhombus Milli-Amp-Master or equal. Typical of four (4) float switches required (two in each chamber of the wetwell). Refer to the Contract Drawings for additional information.

G. TEMPERATURE SENSORS

1. Temperature sensors shall be provided for contractor installation for each building as indicated on the Contract Drawings. The temperature sensors shall be Omega EWS-TX Series Wall Mount Sensor or approved equal. Provide as Omega OSAT series within classified/hazardous areas (Headworks Building, Influent Room) Contractor to provide electrical box, 24 Vdc power supply, circuitry (conduit & conductors) wall plate, and mounting bracket as required for a complete and operable room temperature sensing device per manufacturers recommendations. Refer to Contract Drawings for quantity and general locations.

H. WET FLOOR SENSORS

1. Wet Floor Sensors (where indicated on contract drawings) to be provided as Winland Electronics Inc. Model WaterBug WB200, or approved equal. Provide

12VDC power from associated control panel and monitor relay output for detection of water leaks. Refer to Contract Drawings for quantity and general locations.

I. COMBINATION CARBON MONOXIDE / SMOKE DETECTORS

1. Combination carbon monoxide / smoke detector (where indicated on contract drawings) to be provided as model GN-503F as manufactured by Gentex, or approved equal. Detector to be 120V powered by building electrical system, contain battery back-up, and be UL listed. Detector to feature one (1) set of contacts that activate upon detection of smoke, or carbon monoxide. Install on wall per manufacturer's recommendations and in accordance with NFPA 720. Refer to Contract Drawings for quantity and general locations.

2.4 CHEMICAL LEAK DETECTION ALARMING LIGHTS AND HORNS

A. Contractor to provide LED lights and audible sounder/horns as shown on the Contract Drawings to indicate a chemical leak. Typical of four (4).

B. Lights and sounders/horns shall possess the following features:

1. One LED light with red colored lens and one LED light with green colored lens. Green light will be energized to indicate a ”go” condition and red light and sounder/horn will be energized for “no go” condition.

2. Lights and sounder/horn shall be energized by contact closure within the control panels.

3. Lights and sounder/horn shall operate on 120VAC power (from control panel) by contact closures to each lights LED and sounder. Lights and sounder/horns to be powered out of control panel. Provide necessary power supplies, control transformers, etc. as required to provide an overall complete/operable system.

4. Lights and sounder/horn shall be rated NEMA 4X minimum and shall be suitable for use as indicated/shown on the Contract Drawings.

5. Provide a dome guard to protect lights from physical damage.

6. Sounder/horn shall have a corrosion-resistant housing suitable for mounting outdoors.

7. Provide wall mounting appurtenances and back boxes for lights and sounder/horn as required. Refer to Section 26 0529 Hangers and Supports for Electrical Systems.

8. Each LED light and sounder/horn to be labeled/identified. Refer to Section 26 0553, Identification for Electrical Systems, for additional information.

9. Provide as 3-position vertical stack. First position (bottom) to be sounder, second positon (middle) to be green (go) LED, and third position (top) to be red (no-go) strobe LED.

10. Provide conduit adapter as necessary.

11. Provide indicator ring and legend plate kits as necessary.

12. Manufacturer

    a. Provide light/horn stack as Federal Signal Global Series Custom Configured Fixtures Model # G-MSC-3A-120-NN-LG-SR or approved equal.

    b. Provide conduit adapter as Federal Signal K231247 or approved equal.

2.5 SCADA WORKSTATION AND SOFTWARE

A. A SCADA workstation shall be provided for system control, monitoring, alarming, reporting and historical data retrieval. The SCADA workstation shall communicate with various control panels via the Ethernet network. The SCADA workstation shall be programmed with all required animated system control, monitoring and trending screens. The SCADA workstation and accessories shall be provided with the following features as a minimum:

1. Hardware:

    a. Intel Xeon W3-2423 (15 MB cache, 6 cores, 12 threads, 2.1 GHz to 4.2 GHz Turbo, 120 W).

    b. 32GB, 1x32GB, DDR5, 4800MHz, RDIMM ECC Memory.

    c. Dual 1 TB, M.2, PCIe NVMe, SSD, Class 40 storage controller/hard drive.

    d. Intel 2.5GbE i225 FH PCIe Network Adapter (NIC) Card.

    e. Six (6) USB 2.0 ports.

    f. Dell KB522 Business Multimedia Keyboard (US).

    g. Dell Laser Wired Mouse - MS3220 - Black.

    h. Two (2) 27” flat panel monitors.

    i. Western Digital A9272669 external USB drive, 1TB USB 3.0, with case.

2. Factory installed and Configured Software:

    a. FactoryTalk View SE Standard, 100 display runtime, 9701M-VWSTNST30 or approved equal.

    b. FactoryTalk View SE, Studio for Development, 9701M-VWSSPT30 or approved equal.

c. SYTECH - XLReporter, XL1SM report generation software or approved equal.

d. Windows 11 Pro for Workstations (6 cores), English, French, Spanish, Brazilian Portuguese.

e. Latest version of Microsoft Office Pro, installed, include CD-ROM and manual

f. Virus scan and protection software either McAfee Virus Scan Enterprise or Symantec Nortan AntiVirus Business Pack (latest edition).

3. The computer workstation shall be Dell Precision T5860 with P2722H monitors or approved equal.

2.6 WINDOWS BASED TABLET AND ACCESSORIES

A. A Windows-based tablet shall be provided for remotely accessing and controlling the system via the Internet. The tablet shall as a minimum have an 11.6" screen and shall be provided with Windows 11 professional preloaded and ready for operation when delivered to the owner. The tablet shall have the follow features as a minimum:

1. 8th Gen Intel® Core™ i7-8665U (8 MB cache, 4 cores, 8 threads, up to 1.90 GHz Turbo, 15 W).

2. Operating System: Windows 11 Professional.

3. Microsoft Office Professional, latest version.

4. Memory: 16 GB: LPDDR3, 2133 MT/s (onboard).

5. Hard Drive: 512 GB, M.2, PCIe NVMe, SSD, Class 40.

6. Wireless: Intel® Wireless-AC 9560, 2x2, 802.11ac, MU-MIMO, Bluetooth® wireless card.

7. Mobile Broadband: 5G - Qualcomm® Snapdragon™ X55 Global 5G (DW5930e), Verizon, no NMEA GPS port.

8. Display: 11.6", FHD (1920 x 1080),1000 Nit Outdoor-Readable, AG/AS/Polarizer, Glove-Capable Multi-tch Screen.

9. Battery: 2 Cell, 34 Wh, Lithium Ion, ExpressCharge™ Capable.

10. A/C Adapter: 45W AC adapter.

11. Warranty: 3Year Ltd Hardware Warranty.

12. The Tablet shall be Dell Latitude 7220 Rugged Extreme Tablet or approved equal.

13. Provide accessory 32GB USB stick.
14. Provide with carring case.

2.7 SPARE PARTS

A. The following spare parts shall be provided:

1. One (1) PLC CPU of each type
2. One (1) PLC power supply of each type
3. One (1) PLC I/O module of each type
4. One (1) Protocol Converter of each type
5. One (1) 24VDC panel power supply of each type
6. One (1) UPS of each type
7. Two (2) surge protectors of each type
8. Five (5) fuses of each type
9. Five (5) pilot light bulbs of each type
10. Five (5) miniature circuit breakers of each type/size
11. One (1) Radar Level Transmitter
12. One (1) Capacitance Probe
13. One (1) Open Channel Flow Meter
14. One (1) DO Sensor & Controller
15. One (1) Submersible Level Transducer
16. One (1) Float Switch
17. One (1) Temperature Sensor
18. One (1) Wet Floor Sensor
19. One (1) Combination Carbon Monoxide / Smoke Detector
20. One (1) Leak Detection Horn / Strobe

PART 3 EXECUTION

3.1 INSTALLATION

A. When a change from normal power to emergency power occurs and vice versa all equipment to be restarted automatically. Final requirements to be coordinated with the engineer. Provide as required.

B. Contractor to develop screen programs that mimic that of the vendor supplied control panels. Contractor to work with the owner to develop these screens and integrate within the control panels/control network. Refer to article below for further screen development information.

1. Vendor supplied control panels in which screen programs are to be implemented onto the control panels are to include, but not limited to the following:

a. Two (2) Bar Screen Control Panels (BS-CP-1 & BS-CP-2)

b. Two (2) Grit Removal System Control Panels (GRS-CP-1 & GRS-CP-2)

c. Gas Detection System Control Panel (GDS-CP-1)

d. Four (4) Primary Clarifier Control Panels (PC-CP-1, PC-CP-2, PC-CP-3, & PC-CP-4)

e. Four (4) Scum Pump Control Panels (SP-CP-1, SP-CP-2, SP-CP-3, & SP-CP-4)

f. Primary Sludge Pump Control Panel (PSP-CP-1)

g. Primary Sludge Valve Control Panel

h. Two (2) Microscreen Control Panels (MS-CP-1 & MS-CP-2)

i. MBR Control Panel (MBR-CP-1)

j. ATAD Control Panel (ATAD-CP-1)

k. Rotary Drum Thickener Control Panel (RDT-CP-1)

l. Two (2) Belt Press Control Panels (BP-CP-1 & BP-CP-2)

m. Filtrate Pump Control Panel (FP-CP-1)

n. Plant Water Control Panel (PW-CP-1)

o. Existing Disinfection Building SCADA Control Panel (DBSCP)

p. Three (3) HVAC Monitoring Control Panels (HVAC-400, HVAC-500, & HVAC-700)

q. Two (2) Drain Pump Control Panels (DP-CP-1 & DP-CP-2)

r. Fire Alarm Panels, Security Alarm Panels, & Heat Trace Controllers.

C. Install equipment at locations indicated on the drawings.

D. Point test all PLC I/O to verify that all I/O modules are correctly wired to the terminal strips and that the PLC I/O modules function properly. Testing shall be performed between terminal points on the I/O module to the terminal strip that the field device is terminated on.

E. Contractor to perform point-to-point wire testing on all circuitry entering/leaving the control panels. Verify wire integrity, continuity, and proper transmission of signal.

F. Provide all necessary cable, conduits, and fittings as required to provide a fully operable system. All wiring external to control panels shall be in conduit. Refer to the raceway schedule on the contract drawings for additional information/requirements.

G. Refer to the contract drawings for all field wiring specifications/requirements and I/O Table indicating type and quantity of signals.

3.2 GRAPHIC DISPLAYS/SCREEN DEVELOPMENT

A. System integrator responsible for developing all screens associated with each control panel specified as part of this section and loading onto control panels as required. Coordinate with the owner and engineer.

B. General Requirements:

1. All displays shall contain and continuously update the displayed process variables, date and time of day. All process values shall be displayed in engineering units. All displays shall incorporate references to both instrumentation tag numbers and plant equipment numbers. All process variables shall be displayed on their associated display(s) with correct engineering units. Process variables shall display their associated data quality flags.

2. All operator commands related to controlling field devices or system attributes shall require multiple keystrokes or mouse actions to protect against inadvertent operations. The operator shall receive confirmation of the selected point to be controlled, at which time a cancellation of the control can be affected.

3. Process graphic displays, shall be based on the P&ID's, site plan drawings, mechanical drawings and electrical drawings included as part of these Contract Documents. The graphic displays shall depict process flow streams, process structures, and all major items of process equipment and control devices in a schematic format.

4. All main graphical screens shall include a title bar, main graphic area, navigational buttons, and alarm summary bar. Title bar shall be displayed on the top of each screen and include display name, description and time/date. The

main graphical area shall contain primary screen data in graphical format. Navigational buttons shall include a minimum of main menu, trends, main alarm summary, and security log in. The alarm summary bar shall display the last three valid alarms on the bottom of each screen.

5. Animation shall be provided to mimic level changes in tanks or vessels, and to mimic rotation of rotating equipment when running. Valve colors shall change when opened and closed.

6. Unless specifically noted, all timers, setpoints, alarm actuation levels, etc., shall be adjustable from the operator interface.

7. The system shall show field conditions with text that can alternate (i.e., OPEN/CLOSE, START/STOP, HIGH/LOW) and change color correspondingly. Field devices that are tri state must be represented in three conditions.

8. Conditions in the field designated as alarm conditions shall report to the operator workstation, actuate an audible alarm, and provide a visual blinking image on the associated graphic page. All alarms and events shall be displayed on the screen and archived.

9. All interlocks that affect equipment operation shall be identified both by alarm and by HMI indication.

10. All analog inputs shall be checked for out of range (via high and low limit checks) and alarmed.

11. All process flow streams shall be labeled and color coded. All structures and equipment shall be identified by name and appropriate equipment and loop tags.

12. Color coding for equipment status and alarms shall be as follows:

    a. Green for on or open.

    b. Red for off or closed.

13. Automatically record all alarm and events should any of the following sequences or events occur:

    a. Date/Time entry

    b. Limit changes

    c. Any commanded or un-commanded change of any point

    d. Alarm conditions

    e. PLC activation or deactivation

    f. Operator login or logout activity

C. Specific Requirements:

1. Plant Overview screen shall include a site plan representation, indicating the geographic location of each process, and each building.

2. Main menu screen shall be developed to link to all screens and process areas. The screen shall be a complete and logical listing of the names and number of all screens

3. Overall plant process block flow diagram screen shall show all major processes in block form with flow arrows. Each block shall include a text description of key individual treatment processes. Navigational buttons to the individual treatment processes shall be performed by pressing on the text description.

4. Individual treatment process screens shall graphically screen key process variables and equipment. No operator entries shall be done from these screens. Individual process flow screens for each process shall include all process components, including tanks, pumps, blowers, mixers, drives, flow meters, valves, mechanical devices, as well as manual shutoff and isolation valves. These diagrams shall be generally depicted from the P&ID's and there shall be at least 1 screen per P&ID on average.

5. Individual unit process screens depicted from the P&ID's are used for control and screen of each major item of process equipment, process variables, and control devices, including pumps, blowers, valves, gates, mixers, drives etc. Navigational buttons shall consist of the P&ID's flow arrows to other individual unit processes. The unit process screens shall provide the ability for the operator to go to individual equipment popup screens. These diagrams shall be generally depicted from the P&ID's and there shall be at least 2 screens per P&ID on average.

6. Popup screens shall be provided for each piece of equipment to start/stop equipment, open/close valves, implement automatic control, adjust set points, establish and adjust tuning parameters, set alarm limits and initiate a sequence.

7. PLC system diagnostic screens, showing the operational status, and fault conditions of all PLC components, including processors, I/O modules, OIU's, power supplies and UPS units.

8. Communications diagnostic screens, showing the details of network status, communications status of all major components including Operator Work Stations, peripheral devices and network components.

9. Maintenance screens shall screen the raw value for each analog and digital I/O point in the system. They shall also allow the operators/maintenance personnel to enter an override value for an analog point that is then used by the system instead of the value read from the input card / communications link.

10. Trend screens with the capability to screen up to eight, operator assigned, analog and/or digital process variables. Each analog value will be shown on a trend screen.

11. Main alarm summary screen shall screen the following information on each alarm: Time, tag name, description, alarm type, current value and status. An acknowledge alarm button shall acknowledge all new unacknowledged alarms. The acknowledged and unacknowledged alarms shall be different colors. Acknowledged alarms shall clear automatically after the condition is corrected.

12. Analog variable screens showing a tabular summary of all plant process variables, in operator assigned groupings.

D. Security:

1. The system shall be configured and implemented with security to prevent unauthorized access. The system shall allow authorized changes to system operation through defined user accounts and password verification.

2. Coordinate with Owner user account information, including login name and password for each account.

3. Security levels of "display only", "operator mode", "supervisor mode", and "engineer mode" shall be available through assignable passwords. On system startup, the "display only" security level shall automatically be entered. In the "display only" mode, information is available to be displayed on the screen but no changes may be made. In the "operator mode", changes may be made to process set points, times, etc.; however, the overall control concepts may not be modified. In the "supervisor mode", all operator functions can be modified and any special reports or critical process set points (data can be modified; however, the overall control concepts may not be modified). In the "engineer mode" level, all user modifiable parameters of the system shall be available for modification.

E. Alarm/Equipment Status Reporting:

1. The alarm log shall display all alarms as they occur. The alarm message shall include the time of occurrence, tag name, tag number, and whether it is a low, high, or failure alarm. When the point in alarm returns to normal, the time, point identification number, and return to normal shall be displayed. All reports shall include the plant equipment number of the associated device.

2. The equipment status shall be logged whenever a change in status occurs (i.e., start, stop). The equipment status log shall include the time, equipment name, tag number, and the particular change in status.

F. Historical Data Management:

1. Each system point (analog or digital, real or pseudo) shall have the capability of being historically logged. A point shall have the capability of being deleted from historical log at any time. It shall be easy to add or delete system points using minimal keystrokes.

2. All process analogs and all flow totals and run time indications of all primary process equipment motors shall be sampled and stored in the historical data management system.

3. Data Processing: The real time instantaneous values shall be stored in a historical log file on the hard disk at defined sampling rates.

4. Data Correction: Historical data shall be manually modifiable by personnel with appropriate security levels. Such data shall be differentiated from actual monitored values on reports, in the database and in trends.

5. Data Quality: Data Quality flags shall propagate to the next higher level of the history based on user selectable percentage determining tolerance levels for averages and totals. If the percentage of suspect data exceeds the tolerance level, the suspect data flag propagates to the next higher level. Maximums and minimums shall be taken from good data.

6. Manual Input Data Handling: This data shall consist of additional values not obtainable by the system such as laboratory analysis for use in reports. All manually entered data shall be entered and stored in the appropriate engineering units. All data entered shall be displayed for confirmation on the display prior to incorporation to the database.

G. Reports:

1. Quantity and format of reports shall be coordinated with the owner and as a minimum shall include shift, daily, monthly and yearly reports. Provide a minimum of 5 reports.

2. The system shall be able to generate reports from on-line historical data files or prompt the user for the appropriate archived data files.

3. Reports shall be initiated automatically based upon time of day or manually upon operator request.

4. User interface displays for report generation shall be developed with easy recall of reports by entering time:day:year target values.

5. User interface displays shall allow the operator to define the destination of the report (e.g., display, printer, computer file, etc.) and when it is to be printed (e.g., immediately, on demand, or automatically at a specified time).

6. It shall be possible to print quality tags alongside the value.

7. Values for which there are no data available shall be identified with a special character. Thus, only values which are actually zero shall be printed as such.

8. Operational Report Types. The following operational report types shall be provided with the system:

    a. Shift Operation Summary Report:

1) An operator-adjustable time interval shift operation report shall summarize plant operation from the start and finish time of operation. .

2) The report format shall consist of the following: correct date, plant name, report name, page number, group headings, subheadings, point identification, and engineering units.

b. Daily Operation Summary Report:

1) The daily operation report shall summarize plant operation for the previous day. The printed information shall be the stored values (not averages) including scanned, lab, and manually entered data.

2) The report format shall consist of the following: correct date, plant name, report name, page number, group headings, subheadings, point identifications, and engineering units.

3) The daily minimum, average, maximum, and total where applicable shall also be calculated and printed for each point and stored.

c. Monthly Operation Summary Report:

1) The monthly operation summary report shall summarize plant operation for the previous calendar month.

2) The report format shall be arranged so that the first several pages shall conform to the requirements of the state regulatory agencies and may be separated from the rest of the monthly operation report for transmittal to the regulatory agency.

3) The report format shall be similar to the daily operation summary report and shall consist of the following: month and year, plant name, report name, page number, group headings, sub-headings, point identifications, and engineering units.

4) Monthly minimum, average, maximum, and totals, where applicable, shall also be printed for each column of points printed.

d. Annual Operation Summary Report:

1) The annual operation summary report shall summarize plant operation for the previous calendar year. The report shall consist of scanned data, lab data, and manually entered data.

2) The format of the report shall be identical with the monthly operation summary report except for replacing month with year in the heading and replacing date with calendar month.

3.3 START-UP SERVICE

A. The system integrator/supplier shall provide the services of a qualified service technician/engineer to perform the following service duties. The technician/engineer shall be a direct employee of the Systems Integrator; second party service relationships are not acceptable.

    1. Provide a minimum of three (3) days on-site services to provide installation instruction to the contractor on all aspects of equipment installation.

    2. Provide a minimum of ten (10) days of onsite startup services to provide a final system calibration, programming, and testing after completion of equipment installations.

    3. Provide a minimum of two (2) 8-hour sessions at the job site to provide instruction to facility personnel in the operation, proper maintenance, trouble shooting, and repair of the equipment. Contractor to demonstrate proper operation of system to owner.

    4. Following system startup, contractor is to correct any deficiencies at no additional cost to the owner.

B. Following completion of the above services, the supplier shall provide an affidavit to the facility, certifying that the system is installed and operating in accordance with the contract documents.

END OF SECTION

SECTION 26 0913 - FIRE DETECTION AND ALARM

GENERAL

1.1 SUMMARY

A. All equipment, components, devices, etc... and associated programming, commissioning, startup, training, etc... included within this specification are to be furnished by the contractor thru the bid allowance. The contractor is to include all installation, mounting/hardware, wiring/circuitry (conduit & conductors), terminations, etc... of equipment, components, and devices specified herein within the base bid.

B. Contractor to provide an addressable fire alarm system as specified and shown on the Contract Drawings for the ATAD Building, Dewatering Building, Garage, and MBR Building for a total of four (4) addressable fire alarm systems. Refer to the Contract Drawings for additional information / requirements.

C. This section covers a complete fire alarm system, including all initiating devices, notification appliances, controls, and supervisory devices.

D. Work covered by this section includes the furnishing of labor, equipment, and materials for installation of the fire alarm system as indicated on the Drawings and in the specifications.

E. The fire alarm system shall consist of all necessary hardware equipment and software programming to perform the following functions:

1. Fire alarm system detection and notification operations.

2. Control and monitoring of other equipment as indicated on the Drawings and in the specifications.

F. Refer to Contract Drawings for additional information / requirements.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions, apply to this section.

B. The work covered by this section is to be coordinated with related work as specified elsewhere in the specifications. Requirements of the following sections apply:

1. Section 26 0510 - Basic Electrical Requirements.

2. Section 26 0515 - Electrical Firestopping.

3. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.

4. Section 26 0526 - Grounding and Bonding for Electrical Systems.

5. Section 26 0529 - Hangers and Supports for Electrical Systems.
6. Section 26 0534 - Conduit.
7. Section 26 0537 - Boxes.
8. Section 26 0553 - Identification for Electrical Systems.

C. The system and all associated operations shall be in accordance with the following:

1. Model Fire Code - NFPA.
2. NFPA 72, National Fire Alarm Code.
3. NFPA 70, National Electrical Code.
4. NFPA 101, Life Safety Code.
5. NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
6. Local jurisdictional adopted Codes and Standards.
7. ADA Accessibility Guidelines.

D. Refer to Contract Drawings for fire alarm abbreviations and legend information.

1.3 COORDINATION WITH TRADES

A. The system provider shall coordinate the system design, installation, and testing with all other affected systems and trades.

B. The system design drawings shall include detailed information as to how the fire alarm system will interface with other systems where such connections have been proposed and/or are required.

C. The system design shall also coordinate final equipment and peripheral device locations with all other trades such as light fixtures, dampers, ceilings, mechanical equipment, etc.

1.4 SCOPE OF WORK

A. New Work

1. Provide a complete, addressable, microprocessor-based FACP for the four locations as indicated on the Contract Drawings (ATAD Building, Dewatering Building, Garage, and MBR Building).

a. Four main fire alarm control panels are required as shown on the drawings.

2. Install new addressable and conventional fire alarm devices where indicated on the Contract Drawings. All new devices shall utilize new fire alarm cable. Install conventional devices and associated addressable modules only where specifically called out on the Contract Drawings.

3. Install new addressable pull station devices where indicated on the Contract Drawings. All new pull stations shall utilize new fire alarm cable. Install conventional-type pull station and associated addressable modules only where specifically called out on the Contract Drawings.

4. Provide required signal circuits to accommodate all proposed notification appliance devices. Where necessary, provide additional NAC power supplies and circuits to meet NFPA 72 battery backup requirements.

5. Provide required control panel relays to accommodate all new control circuits.

6. Provide required addressable modules for all new addressable devices plus 25 percent spare capacity for initiating devices, per module.

7. Provide addressable-type duct smoke detectors where indicated on the Drawings.

8. Refer to the Contract Drawings for basis of design equipment.

9. Provide new fire alarm annunciator panels, as indicated on the Contract Documents.

1.5 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 72.

B. Fire alarm signal initiation shall be by one or more of the following devices:

1. Manual stations.

2. Heat detectors.

3. Smoke detectors

4. CO detectors.

5. Duct smoke detectors

C. Fire alarm signal shall initiate the following actions:

1. Alarm notification appliances shall operate continuously.

2. Identify alarm at the FACP and FAA.

3. Transmit an alarm signal to the remote alarm receiving station.

4. Turn off ventilation fans serving zone where alarm was initiated.

5. Record events in the system memory.

6. Refer to Contract Drawings for additional information/requirements.

D. Supervisory Operations - Upon activation of a supervisory device, the system shall operate as follows:

1. Supervisory equipment shall consist of:

a. Carbon monoxide detection devices.

2. Activate the system supervisory service audible signal and illuminate the LED at the control unit.

3. Pressing the Supervisory Acknowledge Key will silence the supervisory audible signal while maintaining the Supervisory LED "On," indicating off-normal condition.

4. Transmission of supervisory signal to the supervising station.

E. System trouble signal initiation shall be by one or more of the following devices or actions:

1. Open circuits, shorts and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.

2. Opening, tampering, or removal of alarm-initiating and supervisory signal-initiating devices.

3. Loss of primary power at the FACP.

4. Ground or a single break in FACP internal circuits.

5. Abnormal ac voltage at the FACP.

6. A break in standby battery circuitry.

7. Failure of battery charging.

8. Abnormal position of any switch at the FACP or annunciator.

1.6 QUALITY ASSURANCE

A. Installer Qualifications - Personnel certified by NICET as Fire Alarm Level III, as supervisor, and NICET I and II all other installers.

B. Installer and equipment vendor shall be licensed by the State of New York to install security and fire alarm systems.

C. Electrical Components, Devices, and Accessories - Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. System provider shall be factory authorized and maintain an office within 100 miles of project site.

E. System provider/installer to be D-BEN Security Systems, Inc. or approved equal. Contact information is as follows:

1. Gregory DeBenedictus

   91 Thompson Street

   Newburgh, NY 12550

   845-565-4024

   dbensec@gmail.com

1.7 SUBMITTALS

A. General - Submit the following according to Conditions of Contract.

1. Alternate products must be submitted to the Engineer at the time of bid for approval. Alternate or as-equal products submitted under this contract must provide a detailed line-by-line comparison of how the submitted product meets, exceeds, or does not comply with this specification.

2. Qualification Data - For Installer

   a. Factory training certificate.

   b. NICET Certification.

   c. NYS Fire/Security System Installation License.

3. Product data sheets for system components highlighted to indicate the specific products, features, or functions required to meet this specification. Alternate or as-equal products submitted under this contract must provide a detailed line-by-line comparison of how the submitted product meets, exceeds, or does not comply with this specification.

4. Indicate the candela ratings and loudness settings for all audible and visual devices planned for installation.

5. Graphic Map - Submit proposed sample floor plan intended for use as the graphic map locator for the FACP.

6. Wiring Diagrams - Power, signal, and control wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Show wiring color code.

7. Shop drawings showing system details including location of FACP, all devices, circuiting and details of graphic annunciator.

8. System power and battery charts with performance graphs and voltage drop calculations to assure that the system will operate in accordance with the prescribed backup time periods and under all voltage conditions per UL and NFPA standards.

9. System operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. A list of all input and output points in the system shall be provided with a label indicating location or use of IDC, SLC, NAC, relay, sensor, and auxiliary control circuits.

10. Operating instructions for FACP.

11. Operation and maintenance data for inclusion in Operating and Maintenance Manual. Include data for each type product, including all features and operating sequences, both automatic and manual. Provide the names, addresses, and telephone numbers of service organizations.

12. Product certification signed by the manufacturer of the fire alarm system components certifying that their products comply with indicated requirements.

13. Record of field tests of system.

1.8 MAINTENANCE SERVICE

A. Maintenance Service Contract - Provide maintenance of fire alarm systems and equipment for a period of 12 months, using factory-authorized service representatives.

B. Basic Services - Systematic, routine maintenance visits on a quarterly basis at times scheduled with the Owner. In addition, respond to service calls within 24 hours of notification of system trouble. Adjust and replace defective parts and components with original manufacturer's replacement parts, components, and supplies.

C. Additional Services - Perform services within the above 12-month period not classified as routine maintenance or as warranty work when authorized in writing. Compensation for additional services must be agreed upon in writing prior to performing services.

D. Renewal of Maintenance Service Contract - No later than 60 days prior to the expiration of the maintenance services contract, deliver to the Owner a proposal to provide contract maintenance and repair services for an additional one-year term. Owner will be under no obligation to accept maintenance service contract renewal proposal.

1.9 FURNISH AND INSTALL EXTRA MATERIALS

A. General - As part of the Bid price, include labor and materials required to fully install the following equipment. Installation shall be as directed by the Engineer and/or Owner during construction. Extra materials not required shall be turned over to the owner at Substantial Completion.

1. Manual Pull Stations - Furnish two extra of each type.

2. Horns and Strobes - Furnish two extra of each type.

3. Smoke Detectors, Heat Detectors, and CO Detectors - Furnish two extra of each type.

4. Detector or Sensor Bases - Furnish two extra of each type.

5. Fuses - Four of each type installed in the system.

6. Relays - (Including Addressable Modules, Relay Modules, Control Modules and Contact Closure Modules) - Furnish two extra of each type.

7. Power Supplies and Batteries - Furnish two extra of each type.

PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers - Basis of design system is Siemens or equal. Refer to Contract Drawings for product basis of design model numbers. Subject to compliance with requirements.

1. Wire and Cable

a. Comtran Corporation.

b. Helix/HiTemp Cables, Inc.; a Draka USA Company.

c. Rockbestos-Suprenant Cable Corporation; a Marmon Group Company.

d. West Penn Wire/CDT; a division of Cable Design Technologies.

2.2 SYSTEM WIRING CONFIGURATION

A. Transmission shall be hard-wired, using separate individual circuits for each zone of alarm operation as required or addressable signal transmission, dedicated to fire alarm service only.

B. System connections for initiating device circuits shall be Class B, Style D, signaling line circuits shall be Class B, Style 4 and notification appliance circuits shall be Class B, Style Y.

2.3 FACP HEAD END CONTROLLER

A. Main FACP or network node shall contain a microprocessor-based Central Processing Unit (CPU) and power supply in an economical space saving single board design. The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, annunciators, and other system-controlled devices. Refer to the Contract Drawings for additional information.

2.4 SYSTEM CAPACITY AND GENERAL OPERATION

A. The FACP shall be capable of communicating on C-WEB Network over a Local Area Network (LAN) or Wide Area Network (WAN) utilizing a peer-to-peer, inherently regenerative communication format and protocol. The network shall support communication speed up to 100 Mb and support up to 200 panels/nodes per network.

B. Each network node shall provide, or be capable of 252 intelligent/addressable devices per SLC loop.

C. The notification appliance circuits shall be programmable to synchronize with System Sensor, Gentex, and Wheelock notification appliances.

D. The system shall include a full featured operator interface control and annunciation panel that shall include a backlit Liquid Crystal Display (LCD), individual color-coded system status LEDs, and an alphanumeric keypad with easy touch rubber keys for the field programming and control of the fire and gas detection system.

E. The system shall be programmable, configurable, and expandable in the field without the need for special tools, PROM programmers, or PC-based programmers. It shall not require replacement of memory ICs to facilitate programming changes.

F. The system shall allow the programming of any input to activate any output or group of outputs. Systems that have limited programming (such as general alarm), have complicated programming (such as a diode matrix), or require a laptop personal computer are not considered suitable substitutes.

G. The FACP shall support up to 20 logic equations, including "and," "or," and "not," or time delay equations to be used for advanced programming. Logic equations shall require the use of a PC with a software utility designed for programming.

H. The FACP or each network node shall provide the following features:

1. Drift compensation to extend detector accuracy over life. Drift compensation shall also include a smoothing feature, allowing transient noise signals to be filtered out.

2. Detector sensitivity test, meeting requirements of NFPA 72.

3. Maintenance alert, with two levels (maintenance alert/maintenance urgent), to warn of excessive smoke detector dirt or dust accumulation.

4. Up to nine sensitivity levels for alarm, selected by detector. The alarm level range shall be 0.5 to 2.35 percent per foot for photoelectric detectors, 0.5 to 2.5 percent per foot for ionization detectors, 0.5 to 4.0 percent per foot for acclimate detectors and 1.0 to 4.0 percent per foot for multi-criteria (IntelliQuad and IntelliQuad PLUS) detectors . The system shall also support sensitive advanced detection laser detectors with an alarm level range of .02 percent per foot to 2.0 percent per foot. The system shall also include up to nine levels of pre-alarm, selected by detector, to indicate impending alarms to maintenance personnel.

5. The ability to display or print system reports.

6. Alarm verification, with counters and a trouble indication to alert maintenance personnel when a detector enters verification 20 times.

I. PAS pre-signal, meeting NFPA 72 requirements.

1. Self-optimizing pre-alarm for advanced fire warning, which allows each detector to learn its particular environment and set its pre-alarm level to just above normal peaks.

2. Cross zoning with the capability of counting - two detectors in alarm, two software zones in alarm, or one smoke detector and one thermal detector.

3. Control-by-time for non-fire operations, with holiday schedules.

4. Day/night automatic adjustment of detector sensitivity.

5. Device blink control for sleeping areas.

J. The FACP shall be capable of coding main panel node notification circuits in March Time (120 PPM), Temporal (NFPA 72 A-2-2.2.2), and California Code. Panel notification circuits (NAC 1,2,3 and 4) shall also support two-stage operation, Canadian dual-stage (3 minutes) and Canadian dual-stage (5 minutes). Two-stage operation shall allow 20 Pulses Per Minute (PPM) on alarm and 120 PPM after 5 minutes or when a second device activates. Canadian dual stage is the same as two-stage except will only switch to second stage by activation of Drill Switch 3- or 5-minute timer. The panel shall also provide a coding option that will synchronize specific strobe lights designed to accept a specific "sync pulse."

K. For flexibility and to ensure program validity, an optional Windows™ based program utility shall be available. This program shall be used to off-line program the system with batch upload/download, and have the ability to upgrade the manufacturers (FLASH) system code changes. This program shall also have a verification utility, which scans the program files, identifying possible errors. It shall also have the ability to compare old program files to new ones, identifying differences in the two files to allow complete

testing of any system operating changes. This shall be in compliance with the NFPA 72 requirements for testing after system modification.

1. This utility shall provide the ability to create and print NFPA-style test and inspection reports.

2. This utility shall provide the ability to create and print Device Maintenance information.

L. The 80-character display keypad shall be an easy to use QWERTY type keypad, similar to a PC keyboard. This shall be part of the standard system and have the capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels shall be provided to prevent unauthorized system control or programming.

M. Each FACP or FACP network node shall support one SLC. Each SLC interface shall provide power to and communicate with up to 159 intelligent detectors (ionization, photoelectric, multi-criteria, thermal, laser, fire/CO) and 159 intelligent modules (monitor, control, relay, releasing) for a loop capacity of 318 devices. SLC shall be capable of NFPA 72 Style 4, Style 6, or Style 7 (Class A or B) wiring.

N. CPU shall receive analog information from all intelligent detectors to be processed to determine whether normal, alarm, pre-alarm, or trouble conditions exist for each detector. The software shall automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information shall also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.

2.5 SERIAL INTERFACES

A. The system shall include two serial EIA-232 interfaces. Each interface shall be a means of connecting UL Listed Information Technology Equipment (ITE) peripherals.

B. EIA-232 interface shall be used to connect an UL-Listed 40 or 80 column printer. Printers that are not UL Listed are not considered acceptable substitutes.

C. The system shall include an EIA-485 port for the serial connection of optional annunciators and remote LCD displays.

D. The EIA-485 interface may be used for network connection to a proprietary-receiving unit.

2.6 SPECIFIC SYSTEM OPERATIONS

A. Smoke Detector Sensitivity Adjust - A means shall be provided for adjusting the sensitivity of any or all addressable intelligent detectors in the system from the system keypad. Sensitivity range shall be within the allowed UL window and have a minimum of nine levels.

B. Alarm Verification - Each of the intelligent addressable smoke detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verification delay shall be programmable from 0 to 60 seconds and each detector shall be able to be selected for verification. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.

C. Point Disable - Any addressable device may be enabled or disabled through the system keypad.

D. Point Read - The system shall be able to display or print the following point status diagnostic functions:

    1. Device status.

    2. Device type.

    3. Custom device label.

    4. View analog detector values.

    5. Device zone assignments.

E. System History Recording and Reporting - The fire alarm control panel shall contain a history buffer that will be capable of storing up to 800 events. Up to 200 events shall be dedicated to alarm and the remaining events are general purpose. Systems that do not have dedicated alarm storage, where events are overridden by non-alarm type events, are not suitable substitutes. Each of these activations will be stored and time and date stamped with the actual time of the activation. The contents of the history buffer may be manually reviewed, one event at a time, or printed in its entirety. The history buffer shall use non-volatile memory. Systems that use volatile memory for history storage are not acceptable substitutes.

F. Automatic Detector Maintenance Alert - The fire alarm control panel shall automatically interrogate each intelligent detector and shall analyze the detector responses over a period of time. If any intelligent detector in the system responds with a reading that is above or below normal limits, then the system will enter the trouble mode, and the particular detector will be annunciated on the system display, and printed on the optional printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.

G. Pre-Alarm Function - The system shall provide two levels of pre-alarm warning to give advance notice of a possible fire situation. Both pre-alarm levels shall be fully field adjustable. The first level shall give an audible indication at the panel. The second level shall give an audible indication and may also activate control relays. The system shall also have the ability to activate local detector sounder bases at the pre-alarm level, to assist in avoiding nuisance alarms.

H. Software Zones - The FACP shall support 142 independent programmable software zones.

I. Multiple Agent Releasing Zones - The system shall support up to 10 releasing zones to protect against 10 independent hazards. Releasing zones shall provide up to three cross-zone and four abort options to satisfy any local jurisdiction requirements.

J. The fire alarm control panel shall include a walk test feature. It shall include the ability to test initiating device circuits and notification appliance circuits from the field without returning to the panel to reset the system. Operation shall be as follows:

1. Alarming an initiating device shall activate programmed outputs, which are selected to participate in walk test, for 3 seconds.

2. Introducing a trouble into the initiating device shall activate the programmed outputs for 8 seconds.

3. All devices tested in walk test shall be recorded in the history buffer.

2.7 COMMUNICATORS:

A. The UDACT shall be compact in size, mounting in a standard module position of the fire alarm control cabinet. Optionally, the UDACT shall have the ability for remote mounting, up to 6,000 feet from the fire alarm control panel. The wire connections between the UDACT and the control panel shall be supervised with one pair for power and one pair for multiplexed communication of overall system status. Systems that utilize relay contact closures are not acceptable.

B. The UDACT shall include connections for dual telephone lines (with voltage detect), per UL/NFPA/FCC requirements. It shall include the ability for split reporting of panel events up to three different telephone numbers.

C. The UDACT shall be capable of transmitting events in 4+2, SIA, and Contact ID.

D. Communication shall include vital system status such as:

1. Independent zone (alarm, trouble, non-alarm, supervisory).

2. Independent addressable device status.

3. AC (Mains) power loss.

4. Low battery and earth fault.

5. System Off Normal.

6. 12- and 24-Hour test signal.

7. Abnormal test signal (per UL requirements).

8. EIA-485 communications failure.

9. Phone line failure

E. The UDACT shall support independent zone/point reporting when used in the Contact ID format. In this format the UDACT shall support transmission of up to 3,064 points. This enables the central station to have exact details concerning the origin of the fire or response emergency.

F. The UDACT shall be capable of being programmed with the same programming utility as the host FACP, and saved, edited and uploaded and downloaded using the utility. UDACT shall be capable of being programmed online or offline. The programming utility shall also support upgrading UDACT operating firmware.

G. The UDACT shall be capable of generating central station reports providing detailed programming information for each point along with the central station point address.

H. An IP or IP/GSM Communicator option shall be available to interface to the UDACT and be capable of transmitting signals over the internet/intranet or cellular (GSM) network to a compatible receiver.

2.8 REMOTE LCD ANNUNCIATOR (FAA)

A. Provide remote LCD fire alarm annunciators where indicated on the Drawings. The Remote LCD annunciator shall use the same Primary Acknowledge, Silence, and Reset Keys; Status LEDs and LCD Display as the FACP.

B. Annunciator shall have super-twist LCD display with 2 lines of 40 characters each. Annunciator shall be provided with four programmable control switches and associated LEDs.

C. Under normal conditions the LCD shall display a "System Is Normal" message and the current time and date.

D. Should an abnormal condition be detected the appropriate LED (Alarm, Supervisory or Trouble) shall flash. The unit audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.

E. The LCD shall display the following information relative to the abnormal condition of a point in the system:

1. 40-character custom location label.

2. Type of device (e.g., smoke, pull station, water flow).

3. Point status (e.g., alarm, trouble).

F. Operator keys shall be key switch enabled to prevent unauthorized use. The key shall only be removable in the disabled position. Acknowledge, Silence and Reset operation shall be the same as the FACP.

2.9 EMERGENCY POWER SUPPLY

A. General - Components include battery, charger, and an automatic transfer switch.

B. Battery - Sealed lead-acid or nickel cadmium type. Provide sufficient capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 24 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all alarm notification devices in alarm mode for a period of 15 minutes.

2.10 ADDRESSABLE MANUAL PULL STATIONS

A. Description - Addressable double-action type, red LEXAN, with molded, raised-letter operating instructions of contrasting color. Station will mechanically latch upon operation and remain so until manually reset by opening with a key common with the control units.

B. Protective Shield - Provide a tamperproof, clear LEXAN shield and red frame that easily fits over manual pull stations. When shield is lifted to gain access to the station, a battery powered piercing warning horn shall be activated. The horn shall be silenced by lowering and realigning the shield. The horn shall provide 85dB at 10 feet and shall be powered by a 9 VDC battery.

2.11 ADDRESSABLE SENSOR BASES

A. Plug-In Arrangement - Sensor and associated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection. Base shall provide break-off plastic tab that can be removed to engage the head/base locking mechanism. No special tools shall be required to remove head once it has been locked.

B. Removal of the detector head shall interrupt the supervisory circuit of the fire alarm detection loop and cause a trouble signal at the control unit.

C. Each sensor base shall contain an LED that will flash each time it is scanned by the control unit (once every 4 seconds). In alarm condition, the sensor base LED shall be on steady.

D. Each sensor base shall contain a magnetically actuated test switch to provide for easy alarm testing at the sensor location.

E. Sensors shall include a communication transmitter and receiver in the mounting base having a unique identification and capability for status reporting to the FACP.

F. Each sensor shall be scanned by the control unit for its type identification to prevent inadvertent substitution of another sensor type. Upon detection of a "wrong device", the control unit shall operate with the installed device at the default alarm settings for that sensor; 2.5 percent obscuration for photoelectric sensor, 135 degrees F and 15 degrees F rate-of-rise for the heat sensor, but shall indicate a "Wrong Device" trouble condition.

G. Provide auxiliary relays in base to provide local control of equipment, such as magnetic door holder release signals.

1. Provide separate 24 volt supply to sensors with auxiliary relays to guarantee that sufficient power will be available to operate relays.

2.12 SMOKE DETECTORS

A. General - Comply with UL 268, Smoke Detectors for Fire Protective Signaling Systems. Include the following features:

1. Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.

2. Factory Nameplate - Serial number and type identification.

3. Operating Voltage - 24 VDC, nominal.

4. Self-Restoring - Detectors do not require resetting or readjustment after actuation to restore normal operation.

5. The sensors electronics shall be immune from nuisance alarms caused by EMI and RFI.

6. Removal of the sensor head for cleaning shall not require the setting of addresses.

B. Type - Smoke sensors shall be of the photoelectric or combination photoelectric/heat type.

C. Bases - Relay output, sounder and isolator bases shall be supported alternatives to the standard base. Refer to Contract Drawings for locations of sounder bases.

2.13 HEAT SENSORS

A. Fixed temperature type or combination rate of rise and fixed temperature type. Refer to Contract Drawings for additional information.

B. Self-Restoring - Sensors do not require resetting or readjustment after actuation to restore them to normal operation.

C. The sensors electronics shall be immune from false alarms caused by EMI and RFI.

D. Sensor fixed temperature sensing shall be independent of rate-of-rise sensing and programmable to operate at 135 or 155 degrees F. Sensor rate-of-rise temperature detection shall be selectable at the FACP for either 15 or 20 degrees F per minute.

E. Sensor shall have the capability to be programmed as a utility monitoring device to monitor for temperature extremes in the range from 32 to 155 degrees F.

F. Heat sensors shall be UL listed for 30 feet by 30 feet coverage (layout based on).

G. Fixed temperature heads for boiler rooms shall be selected/programmed for 200 degrees F.

2.14 DUCT SMOKE DETECTOR

A. Refer to the Contract Drawings for basis of design information.

B. Photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied. Sensor includes relay as required for fan shutdown.

C. Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct smoke sensor shall be provided by the FACP.

D. The duct housing shall provide a supervised relay driver circuit for driving up to 15 relays with a single "Form C" contact rated at 7A@ 28VDC or 10A@ 120VAC. This auxiliary relay output shall be fully programmable. Relay shall be mounted within 3 feet of HVAC control circuit.

    1. Duct detector activation shall signal the FACP and provide local air handler/mechanical unit shutdown. Furnish and install necessary wire, conduit and relay contacts as necessary for unit shutdown.

E. Duct housing shall provide a relay control trouble indicator Yellow LED.

F. Duct housing shall have a transparent cover to monitor for the presence of smoke. Cover shall secure to housing by means of four captive fastening screws.

G. Duct housing shall provide two test ports for measuring airflow and for testing. These ports will allow aerosol injection in order to test the activation of the duct smoke sensor.

H. Duct housing shall provide a magnetic test area and red sensor status LED.

I. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.

J. Each duct smoke sensor shall have a Remote Test Station with an alarm LED and test switch.

K. Where indicated, provide a NEMA 4X weatherproof duct housing enclosure that shall provide for the circulation of conditioned air around the internally mounted addressable duct sensor housing to maintain the sensor housing at its rated temperature range. The housing shall be UL Listed to Standard 268A.

2.15 CO DETECTION

A. Provide non-addressable CO detection device and equip with an addressable monitor module that shall supervise the onboard contact closure.

B. CO detector shall be UL 2075 listed.

C. Suitable for wall and/or ceiling mounting.

D. Shall be equipped with End-of-Life alerting.

E. FACP Programming - Program FACP to annunciate a supervisory condition when CO has been detected.

F. Equipment shall also be self-sounding and shall utilize the Temporal 4 signal style.

2.16 STANDARD ALARM NOTIFICATION APPLIANCES

A. Horn - Piezoelectric type horn shall be listed to UL 464. The horn shall have a minimum sound pressure level of 85 dBA @ 24VDC. The horn shall mount directly to a standard single gang, double gang, or 4-inch square electrical box without the use of special adapter or trim rings.

B. Visible/Only - Strobe shall be listed to UL 1971. The V/O shall consist of a xenon flash tube and associated lens/reflector system. The V/O enclosure shall mount directly to standard single gang, double gang, or 4-inch square electrical box without the use of special adapters or trim rings.

    1. Candela outputs (15cd, 30cd, 75cd and 110cd) shall be field selectable through the use of a DIP switch.

C. Audible/Visible - Combination Audible/Visible (A/V) Notification Appliances shall be listed to UL 1971 and UL 464. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. The audible/visible enclosure shall mount directly to standard single gang, double gang, or 4-inch square electrical box without the use of special adapters or trim rings.

    1. The horn shall have a minimum sound pressure level of 85 dBA @ 24VDC.

    2. Candela outputs (15cd, 30cd, 75cd and 110cd) shall be field selectable through the use of a DIP switch.

D. Notification Appliance Circuit provides synchronization of strobes at a rate of 1 Hz and operates horns with a Temporal Code Pattern operation. The circuit shall provide the capability to silence the audible signals, while the strobes continue to flash, over a single pair of wires. The capability to synchronize multiple notification appliance circuits shall be provided.

2.17 NAC POWER EXTENDER PANELS

A. Provide as required to meet the design intent as proposed by the Contract Drawings.

B. Propose final locations during the shop drawing phase. Provide a dedicated protective system smoke detector above each panel, in accordance with the latest NFPA 72 requirements.

C. Two Class A or Class B Notification Appliance Circuits.

D. 6- or 8-amp full load output panels.

E. Fully regulated and filtered power output.

F. Include integral battery charger capable of charging up to 18AH batteries.

2.18 FACP POWER SUPPLY

A. Provide (2)#12 and #12G, 3/4"C to panelboards as indicated on the Contract Drawings. Provide lock on provisions for breaker.

2.19 CONTROL RELAYS

A. Control relays shall be used for fire alarm unit shutdown and other similar-type branch circuits. Contacts shall be 120 volt coil, 2-pole, 20 ampere, industrial quality.

2.20 CONDUIT AND WIRE

A. Conduit - to comply with 26 05 34. A few requirements to highlight:

1. Conduit shall be used in accordance with the National Electrical Code (NEC) and local and state requirements. Conduit shall be Red in color, no exceptions.

2. Install wiring in conduit or raceway. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.

3. Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, per NEC Article 760-55.

4. Wiring for 24 volt DC control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.

5. Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or back boxes, except where conduit entry is specified by the FACP manufacturer.

6. Conduit shall be 3/4-inch minimum.

7. Refer to the raceway schedule on the Contract Drawings for required raceway product to use in each area.

B. Wire - to comply with 26 05 19. A few requirements to highlight:

1. All fire alarm system wiring shall be new.

2. Wiring shall be in accordance with local, state and national codes (e.g., NEC Article 760) and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 14 AWG.

3. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.

4. Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPLR).

5. Wiring used for the multiplex communication circuit (SLC) shall be twisted and unshielded and support a minimum wiring distance of 12,500 feet. The design of the system shall permit use of IDC and NAC wiring in the same conduit with the SLC communication circuit.

6. All field wiring shall be electrically supervised for open circuit and ground fault.

7. The fire alarm control panel shall be capable of t-tapping Class B (NFPA Style 4) Signaling Line Circuits (SLCs). Systems that do not allow or have restrictions in, for example, the amount of t-taps, length of t-taps etc., are not acceptable.

C. Terminal Boxes, Junction Boxes and Cabinets - All boxes and cabinets shall be UL listed for their use and purpose.

D. Initiating circuits shall be arranged to serve like categories (manual, smoke, water flow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices.

EXECUTION

3.1 INSTALLATION, GENERAL

A. Install system components and all associated devices in accordance with applicable NFPA standards and manufacturer's recommendations.

B. Installation personnel shall be supervised by persons who are qualified and experienced in the installation, inspection, and testing of fire alarm systems. Examples of qualified personnel shall include, but not be limited to, the following:

1. Factory trained and certified personnel.

2. National Institute of Certification in Engineering Technologies (NICET) Fire Alarm Level II certified personnel.

3. Personnel licensed or certified by state or local authority.

3.2 EQUIPMENT INSTALLATION

A. Furnish and install a complete Fire Alarm System as described herein and as shown on the plans. Include sufficient control unit(s), annunciator(s), manual stations, automatic fire detectors, smoke detectors, audible and visible notification appliances, wiring, terminations, electrical boxes, and all other necessary material for a complete operating system.

B. Install manual station with operating handle 48 inches above floor. Install wall mounted audible and visual notification appliances not less than 80 inches above floor to bottom of lens and not greater than 96 inches above floor to bottom of lens.

C. Where necessary, provide temporary plastic bags or other protective coverings over detectors after installation to maintain protection and cleanliness. Remove prior to completion and system commissioning.

D. Automatic Detector Installation - Conform to NFPA 72.

3.3 PREPARATION

A. Coordinate work of this section with other affected work and construction schedule.

3.4 WIRING INSTALLATION

A. System Wiring - Wire and cable shall be a type listed for its intended use by an approval agency acceptable to the Authority Having Jurisdiction and shall be installed in accordance with the appropriate articles from the current approved edition of NFPA 70 and NFPA 72.

B. Contractor shall obtain from the fire alarm system manufacturer written instruction regarding the appropriate wire/cable to be used for this installation. No deviation from the written instruction shall be made by the Contractor without the prior written approval of the fire alarm system manufacturer.

C. Color Coding - Color code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm initiating device circuits wiring and a different color code for supervisory circuits. Color code notification appliance circuits

differently from alarm-initiating circuits. Paint fire alarm system junction boxes and covers red.

D. Make all fire alarm wiring continuous from terminal to terminal or from terminal to device pigtail lead.

    1. Circuit splices not permitted.

    2. Wiring joints, only when required at device pigtail leads shall utilize Scotchlok insulate conical spring connectors (or equal).

E. Mount end-of-line device in a separate box adjacent to last device for Class "B" supervision.

3.5 BATTERIES

A. The battery shall have sufficient capacity to power the fire alarm system for not less than 24 hours plus 5 minutes of alarm upon a normal AC power failure.

B. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills, and leakage shall not be required.

C. If necessary to meet standby requirements, external battery and charger systems may be used.

3.6 FIRE ALARM UNIT SHUTDOWN

A. Provide all contacts/relays control modules and associated control wiring as required to accommodate shutdown of HVAC units (supply and exhaust fans). Refer to Contract Drawings for details.

B. Mechanical Unit Shutdown Control:

    1. Provide shutdown control through Fire Alarm Control Panel.

    2. Upon activation of fire alarm, the associated “shutdown” relay/contactor shall become energized and remove power from the equipment.

    3. Upon restoration of fire alarm system, relay/contactor shall become un-energized and restore power to the associated equipment.

3.7 FIELD QUALITY CONTROL

A. Manufacturer's Field Services - Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pre-testing, testing, and adjustment of the system.

B. Service personnel shall be qualified and experienced in the inspection, testing, and maintenance of fire alarm systems. Examples of qualified personnel shall be permitted to include, but shall not be limited to, individuals with the following qualifications:

1. Factory trained and certified.

2. National Institute for Certification in Engineering Technologies (NICET) fire alarm certified.

3. International Municipal Signal Association (IMSA) fire alarm certified.

4. Certified by a state or local authority.

5. Trained and qualified personnel employed by an organization listed by a national testing laboratory for the servicing of fire alarm systems.

C. Determine, through pre testing, the conformance of the system to the requirements of the Drawings and specifications. Correct deficiencies observed in pre-testing. Replace malfunctioning equipment as required for a complete and operable system.

D. Inspection

1. Inspect equipment installation, interconnection with system devices, mounting locations, and mounting methods.

2. Verify that units and controls are properly installed, connected, and labeled and that interconnecting wires and terminals are identified.

E. Acceptance Operational Tests

1. Perform operational system tests to verify conformance with specifications.

a. Each alarm initiating device installed shall be operationally tested. Each device shall be tested for alarm and trouble conditions. Contractor shall submit a written certification that the Fire Alarm System installation is complete including all punch-list items. Test battery operated emergency power supply. Test emergency power supply to minimum durations specified. Test Supervising Station Signal Transmitter. Coordinate testing with Supervising Station monitoring firm/entity.

b. Test each Notification Appliance installed for proper operation. Submit written report indicating sound pressure levels at specified distances.

c. Test Fire Alarm Control Panel.

2. Provide minimum 10 days' notice of acceptance test performance schedule to Owner, and local Authority Having Jurisdiction.

F. Retesting - Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the specifications and complies with applicable standards.

G. Report of Tests and Inspections - Provide a written record of inspections, tests, and detailed test results in the form of a test log. Use NFPA 72 Forms for documentation.

H. Final Test and Record of Completion - Test the system as required by the Authority Having Jurisdiction. Provide completed NFPA 72 Record of Completion form to Owner and Authority Having Jurisdiction.

3.8 CLEANING AND ADJUSTING

A. Cleaning - Remove paint splatters and other spots, dirt, and debris. Clean unit internally using methods and materials recommended by manufacturer.

B. Occupancy Adjustments - When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound pressure levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to three visits to the site for this purpose.

3.9 TRAINING

A. Provide the services of a factory-authorized service representative to demonstrate the system and train Owner's maintenance personnel as specified below.

1. Train Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintaining of the system. Provide a minimum of eight hours of training.

2. Schedule training with the Owner at least seven days in advance.

END OF SECTION

SECTION 26 0914 - HEAT TRACING CABLES

GENERAL

1.1 SECTION INCLUDES

A. Self-regulating parallel resistance electric heating cable.

1.2 RELATED SECTIONS

A. All Division 26

1.3 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meeting - Conduct a pre-installation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

B. Provide ground fault protection for electric heat tracing circuits as required by NFPA 70.

C. Provide circuit breaker ratings suitable for installed circuit lengths.

D. Where Class I, Division 1 rated heat tracing cables and components are utilized, the Contractor is to fill out any necessary paperwork the manufacturer might require to complete the purchase of the hazardous rated materials.

E. Utilize -30 degrees F design temperature when performing calculations.

1.4 SUBMITTALS

A. Product Data - Provide data for electric heat tracing and all associated components.

B. Shop Drawings - Indicate electric heat tracing layout, electrical terminations, thermostats, controls, and branch circuit connections.

C. Manufacturer's Installation Instructions - Indicate installation instructions and recommendations.

D. Project Record Documents - Record actual locations of electric heat tracing lines, thermostats, and all ancillary equipment.

E. Operation and Maintenance Data - Include manufacturer's descriptive literature, operating instructions of equipment and controls, maintenance and repair data, and parts listings.

F. Warranty - Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

G. Calculations - Contractor to submit manufacturer’s calculations to verify design intent will be met utilizing the specified heating cables. Manufacturer’s calculations to take into

account pipe type, pipe contents, pipe length, pipe fittings, temperature, etc. Contractor to coordinate closely with Applicable Trade Contractor, Owner, and Engineer to obtain all necessary info to provide to manufacturer during submittal phase.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications - Company specializing in manufacturing the products specified in this section with minimum three years' documented experience.

B. Acceptable Installers - Familiar with the installation of heat-trace cabling and equipment, subject to compliance with requirements of the Contract Documents.

1.6 WARRANTY

A. Provide two-year manufacturer warranty for cables, connection kits, accessories, controls, and all related components including insulation system.

PRODUCTS

2.1 SELF-REGULATING PARALLEL RESISTANCE ELECTRIC HEATING CABLE

A. Manufacturers

1. Thermon Manufacturing Company, www.thermon.com.

a. Source Limitations - Furnish heat trace system and associated components and accessories produced by a single manufacturer and obtained from a single supplier.

2. Approved equal.

B. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to authority having jurisdiction.

C. Factory Rating and Testing - Comply with IEEE 515.1.

D. Heating Element

1. Provide pair of parallel No. 16 tinned or nickel coated stranded copper bus wires embedded in cross linked conductive polymer core with varying heat output in response to temperature along its length.

2. Terminations - Waterproof, factory assembled, non-heating leads with connector at one end and water-tight seal at opposite end.

3. Capable of crossing over itself without overheating.

E. Insulated Jacket - Flame-retardant polyolefin.

F. Cable Cover - Provide tinned copper and polyolefin outer jacket with UV inhibitor.

G. Maximum Power On Operating Temperature - 150 degrees F (65 degrees C).

H. Maximum Power-Off Exposure Temperature - 185 degrees F (85 degrees C).

I. Electrical Characteristics

1. 5 W/linear ft.

2. 208 volts, single phase, 60 Hertz.

J. Heating cables to be BSX 5-2 OJ, 208-240 VAC self-regulating cables by Thermon or approved equal. Provide a length of heating cables for each of the two segments of pipe as shown on the Contract Drawings and specified within.

K. Provide heating cables suitable for use within an NEC Class I, Division 1, Group D area as indicated on the Contract Drawings.

L. Provide additional heating capacity for all valves, pipe supports, wall penetrations, and similar heat sinks as required.

M. Suitable for installations in outdoor area.

N. Contractor to confirm with manufacturer that cables are suitable to accomplish design intent thru manufacturer provided calculations. Provide additional heat trace cables as required to meet design intent. Refer to Contract Drawings to obtain pipe run lengths, elbows, fittings, etc. Coordinate requirements closely with owner, engineer, and general contractor.

2.2 CABLE OUTER JACKET MARKINGS

A. Name of manufacturer, trademark, or other recognized symbol of identification.

B. Catalog number, reference number, or model.

C. Month and year of manufacture, date coding, applicable serial number, or equivalent.

D. Agency listing or approval.

E. Provide aluminum foil tape for heat trace cables.

2.3 CONNECTION KITS

A. Provide power connection, splice/tee, and end seal kits compatible with the heating cable and without requiring cutting of the cable core to expose bus wires. Components to be per manufacturers recommendations.

B. Furnish with NEMA 4X rating for prevention of corrosion and water ingress (connection kits to be installed outside the hazardous area as identified on the contract drawings).

C. Provide two-piece DP, termination style connection boxes, as manufactured by Thermon or approved equal. One for each segment of heat trace specified/shown on the Contract Drawings.

D. Provide PETK-1D and SCTK-1D connection kits as manufactured by Thermon or approved equal. Provide one of each for each length of heat trace specified/shown on the Contract Drawings. In addition, Contractor to provide end of circuit beacon lights (DE-B) as manufactured by Thermon of approved equal for each segment of heat trace specified on the Contract Drawings. Contractor to field locate these devices per manufacturers' recommendations. Coordinate final location with the owner.

E. Provide Class I, Division I rated connection/termination kits where heat tracing is to be applied/utilized in hazardous areas as indicated on the Contract Drawings.

2.4 ACCESSORIES

A. Provide accessories as indicated or as required for complete installation including, but not limited to:

1. High temperature, glass filament tape for attachment of heating cable to metal piping.

2. Aluminum self-adhesive tape for attachment of heating cable to plastic piping.

3. Heat-conductive putty.

4. Cable ties.

5. Silicone end seals and splice kits.

6. Installation clips.

7. Warning labels for attachment to exterior of piping insulation. Apply per manufacturers' recommendations.

2.5 CONTROLS

A. Provide RTD, pipe sensing, NEMA 4X rated as manufactured by Thermon or approved equal for each segment of heat trace specified on the Contract Drawings.

1. Control to be set to make contact upon temperature falling to 40 degreess F and shall open on temperature rising above 40 degree F.

2. Provide explosionproof rated device if installed within classified space as identified on the contract drawings.

B. Provide TC201A-SSR30B-240-F-P3 (dual input) single circuit digital controller (208-240 VAC) as manufactured by Thermon or approved equal for each segment of heat trace

specified/shown on the Contract Drawings. Contractor to field locate device and provide all necessary circuitry for a complete and operable system.

C. Provide Class I, Division I rated devices where heat tracing is to be applied/utilized in hazardous areas as indicated on the Contract Drawings.

2.6 INSULATION

A. Provide 2 inches thick of insulation around all pipes in which heat trace cables are to be installed.

B. Insulation to be polyisocyanurate foam or approved equal.

1. Rigid bolded polyisocyanurate foam.

2. "K" value - ASTM C335, 0.19 at 75 degrees F.

3. Minimum Service Temperature -297 degrees F.

4. Maximum Service Temperature - 300 degrees F.

5. Maximum Moisture Absorption - 2 percent by volume.

6. Provide all system accessories as recommended by the insulation manufacturer.

C. Jacketing

1. Provide aluminum jacket with a smooth finish and minimum thickness of 0.016 inches per sheet.

2. Joining - longitudinal slip joints and 2-inch laps.

3. Fittings - 0.016 inch thick die-shaped fitting covers with factory attached protective liner.

4. Metal Jacket Bands - 3/8 inch wide, 0.016-inch thick aluminum.

5. All valves and fittings shall be insulated with a flexible, reusable insulation jacketing, the insulation and jacket shall match that of the piping system.

EXECUTION

3.1 EXAMINATION

A. Verify that piping and equipment are ready to receive work.

B. Verify field measurements are as shown on shop drawings.

C. Verify required power is available, in proper location, and ready for use.

3.2 PREPARATION

A. Clean all surfaces prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer.

3.3 INSTALLATION

A. Contractor to heat trace all segments of pipe as indicated on the Contract Drawings.

B. Contractor responsible for all necessary power, control, and interlock circuiting as necessary to ensure a complete and fully operable heat trace system as shown on the Contract Drawings and specified herein.

C. All pipe bends, elbows, valves, and other fittings may not be shown on the contract drawings, contractor to field verify and provide heat tracing system that accommodates installed pipe system including all bends, elbows, valves, fittings, etc..

D. Install all components as specified above in accordance with manufacturer's recommendations. Provide all necessary circuiting, junction boxes, and ancillary equipment to provide a complete and operable heat trace system.

E. All requirements to be per National Electrical Code.

F. Comply with installation requirements of IEEE 515.1 and NFPA 70, Article 427.

G. Apply heating cable linearly on pipe with fiberglass tape only after piping has successfully completed any required pressure testing.

H. Comply with all national and local code requirements.

I. Grounding - Refer to Section 26 0526, Grounding and Bonding For Electrical Systems.

J. Identification - After thermal insulation installation, apply external pipeline decals to indicate presence of the thermal insulation cladding at intervals not to exceed 20 feet (6 m) including cladding over each valve or other equipment that may require maintenance.

K. Equipment Wiring - Refer to Section 26 2717, Equipment Wiring.

L. Install pipe insulation, jacketing, asphalt coating, reinforcing fabric, strapping tape, boar coating, and high temperature sealant per manufacturers’ written instructions/ recommendations.

M. Provide ground fault protection for electric heat tracing circuits as required by NFPA 70. All heat trace circuits shall be powered by a class B (30 mA) GFI.

N. Provide circuit breaker ratings suitable for installed circuit lengths. Coordinate with equipment manufacturer.

3.4 FIELD QUALITY CONTROL

A. Perform start-up by factory technician or factory representative as per Owner's requirements.

B. Field Testing and Inspections

1. Commission system in accordance with installation and operation manual.
2. Inspect for sources of water entry and proper sealing.
3. Inspect weather barrier to confirm that no sharp edges are contacting the trace heating.
4. Minimum Acceptable Insulation Resistance - 20 megohms or greater at a test voltage of 2500 VDC for polymer insulated trace heaters.
5. Test heating cable integrity with megohmmeter at the following intervals:
    a. Before installing the cable.
    b. After cable has been installed onto the piping.
    c. Prior to initial start-up (commissioning).
6. Measure voltage and current at each unit.
7. Controls - Verify control parameters are set to the application requirements.

3.5 CLOSEOUT ACTIVITIES

A. Demonstrate operation of controls and train owner's representatives. Assume one eight-hour training session will be required.

3.6 PROTECTION

A. Protect installed products from damage until completion of project.

END OF SECTION

SECTION 26 0915 - FIBER OPTIC CABLING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fiber Optic Cable & Accessories

B. Fiber Optic Patch Panel

C. Installation

D. Terminations & Testing

E. Commisioning, Startup Services, & Training

1.2 RELATED SECTIONS

A. All Division 26 Specifications

1.3 REFERENCE STANDARDS

A. Underwriters Laboratories, Inc. (UL)

1. UL 1581 VW-1; Vertical Tray Cable Flame Test.

2. UL 1666 Riser Cable.

B. IEEE Standard 383-1974 Flame Retardancy.

C. ANSI/NECA/BICSI 568-2001, Standard for Installing Commercial Building Telecommunications Cabling.

D. ANSI/TIA/EIA-569-A for maximum length of conduit and bends between pull points and pull box sizing.

E. ISO/IEC 11801 - Type OM3 fiber

F. IEC 60793-2-10 - Type A1a.2 fiber

G. All wiring shall be in complete conformance with the National Electrical Code, State, local and NEMA electrical standards. All incoming and outgoing wires (within control panels whether new or existing) shall be connected to numbered terminal blocks and all wiring neatly tied and fastened to chassis as required.

H. All equipment and installations shall satisfy applicable Federal, State, and local codes.

I. Furnish products listed and classified by Underwriters Laboratories (UL), CSA, or FM approval as suitable for purpose specified and indicated.

1.4 REQUIRED MEETINGS & COORDINATION

A. Contractor to coordinate communication requirements with other suppliers of Ethernet/fiber-based systems and control panels. Refer to Contract Drawings for system architecture.

1. Coordinate with the general contractor, engineer, and owner as it relates to the proposed process equipment and control panels shown on the Contract Drawings that are provided by others.

2. All meetings to take place at the project site.

1.5 SUBMITTALS

A. Contractor to provide one (1) electronic copy of the following documentation:

1. Bill of Materials.

2. Vendor Data/Product Sheets.

3. System Warranty (see below).

4. Cable pulling plan that specifies the sequence of work tasks, materials and equipment used, and a schedule for the work. PDF drawings illustrating all runs of fiber, patch panels (if required), network cabinets (if required), transition from jacked cable to individual fibers, Ethernet switches, and PLCs.

    a. Cable pulling plan to generally show routing of specified fiber optic cabling.

5. Proposed test equipment to be used including optical time domain reflectometer (OTDR) and power meter, including make and model number. Detail the exact procedure that will be utilized to test cable reels once they are delivered to the site. Separately detail the procedure that will be utilized to test installed cables.

1.6 WARRANTY

A. The Contractor shall provide with the above submittals, a written parts warranty against system failure for twelve (12) months from system startup, not to exceed eighteen (18) months from date of shipment from their factory. This warranty period will, with the exception of human negligence or acts of nature such as lightning, floods, etc., provide for repair or replacement of any defective or failed components, at the project site, and at no cost to others.

1. Warranty to include all equipment, hardware, devices, cabling, instruments, etc. that are specified and provided as part of this specification.

1.7 QUALITY ASSURANCE

A. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.

PART 2 - PRODUCTS

2.1 FIBER OPTIC CABLING

A. General Requirements

1. Refer to Contract Drawings for routing and length requirements.

a. Contractor to provide pull points as necessary. Note, pull points not always shown on the Contract Drawings for clarity.

b. Provide in continuous lengths. No splices permitted.

2. Provide multi-mode, optical glass fiber cores compatible with LED-based transmission systems and the media switch specified below.

3. All-plastic fiber-core construction is not acceptable.

4. Provide as OM4 rated.

B. Fiber Optic Cable

1. Heavy duty, tight-buffered or gel-filled construction with additional strength members, PVC inner jacket, and oil, water, and chemical resistant, UV stabilized, flame retardant, polyethylene outer jacket, designed for indoor/outdoor application and direct burial.

2. Cable Specifications

a. Fiber Size - 50 micron/125 micron (core/cladding diameter).

b. Fiber Count - twelve fibers (minimum).

c. Maximum Short-Term Tensile Load - 300 lb.

d. Maximum Long-Term Tensile Load - 180 lbs.

e. Crush Resistance - 80 pounds per square inch.

f. Operating Temperature - -40 to +50 degrees C.

g. Fibers shall have the following optical properties:

1) Maximum attenuation at 850 nm wavelength - 2.5 dB/km.

2) Maximum attenuation at 1300 nm wavelength - 0.8 dB/km.

3) Minimum bandwidth at 850 nm wavelength 1500 MHz/km.

4) Minimum bandwidth at 1300 nm wavelength - 500 MHz/km.

5) Numerical aperture - 0.250 + 0.015.

3. Provide LC style connectors for terminating cabling at media switches, patch panels, control panels.

4. All unused fibers are to be coiled within plastic wire duct for protection. Provide additional plastic wire duct within control panel as necessary. Contractor to field verify.

C. Manufacturer

1. Corning, Model ClearCurve.

2. OFS Laboratories, Model LaserWave 300.

3. Belden.

4. Approved equal.

2.2 FIBER OPTIC PATCH PANEL

A. Contractor to provide a 6-pair (12-port) fiber optic patch panel within a NEMA 1 enclosure. Install patch panel adjacent to each control panel where fiber optic cable is shown as being terminated. Patch panel to accept incoming fiber optic cabling. Fiber optic patch panel enclosure to be item # FE-WM12PP as manufactured by L-com or approved equal. Fiber optic patch panel to be item # FSP-LCD6-BR as manufactured by L-com or approved equal.

B. Provide all necessary patch cables, breakout kits, connectors, and termination kits.

C. Contractor to field verify/locate. Locate adjacent to proposed control panels. Coordinate final location with the owner and all trade contractors prior to rough-in.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Contractor responsible for terminating and testing incoming fiber optic cabling at locations as shown on the Contract Drawings. Provide all necessary connectors, patch cables, breakout kits, terminations, etc..

B. Install equipment at locations indicated on the drawings. Install fiber optic cabling per approved cable pulling plan (refer to above submittal requirements).

C. Provide Maxcell Fabric Innerduct within all conduit systems which are to contain Fiber Optic Cable. Refer to Contract Drawings for additional information.

D. Provide all necessary cable, conduits, and fittings as required to provide a fully operable system. All wiring to be in conduit. Refer to the contract drawings for additional information/requirements.

E. Install fiber optic cabling per manufacturer requirements.

    1. Adhere to ANSI/TIA/EIA-569-A for maximum length of conduit and bends between pull points and pull box sizing.

    2. Lubricate cables during installation. Do not exceed cable manufacturer's specifications for tensile strength and bending radius.

    3. Label cables and reels prior to pulling cable into place. Labeling to be in accordance with ANSI/TIA/EIA-606 standards.

    4. Provide adequate put-up lengths on cable reels to make termination-to-termination runs without splices. Spliced cables are not acceptable.

    5. Support cables in riser conduits at intervals as required by NEC and cable manufacturer.

F. Contractor to perform point-to-point wire testing on all circuitry entering/leaving the control panels. Verify wire integrity, continuity, and proper transmission of signal.

G. Refer to the contract drawings for all field wiring specifications/requirements.

3.2 CHECKOUT, TESTING, AND CERTIFICATION

A. Upon receipt of fiber optic cable reels at the site, perform pre-installation ("on the reel") OTDR measurements on each strand of optical fiber to verify attenuation, length and continuity. The optical fiber shall be tested using a multimode OTDR at 850-nm wavelength. Record the results of all measurements and submit to the Engineer within one week after cable delivery to the site. Cable reels that fail continuity or that have higher than specified attenuation (greater than 3 dB) shall be subject to rejection and shall be replaced at no additional cost to the Owner.

B. Make the following tests after cable installation:

    1. Visually inspect terminations for out-of-round condition and surface defects such as micro-chips and cracks using a 200x inspection microscope.

    2. Upon completion of the cable installation, including all connectors, perform 100 percent bi-directional end-to-end loss testing on each optical fiber. The

multimode fiber shall be tested using Light Emitting Diode (LED) sources (insertion loss test set and power meter) operating at 850 nm wavelength.

3. The calculated and measured values of the end to end shall vary by no more than +0.75 dB. End-to-end losses shall not exceed 3 dB. In the event that any differences are in excess, implement troubleshooting techniques and methods to provide agreement. If the discrepancies cannot be reconciled, the cable installation shall be removed, replaced, and retested at no additional cost to the Owner.

C. Verify proper identification numbering and color coding on cables and fibers.

D. Install, test, and service equipment as necessary to accommodate the sequence of construction.

E. Perform an additional one visit of on-site testing of fiber with OTDR test equipment at the request of the Engineer to assist in the troubleshooting of network issues as necessary to eliminate the fiber as the source of potential network issues.

F. Unless waived in writing by the Engineer, all tests shall be made in the presence of a duly authorized representative of the Owner. When the presence of such representative is so waived, certified results of the tests made and the results thereof shall be furnished by the Contractor.

G. All tests shall be performed in the presence of the Owner. Written notice of all tests shall be given to the Engineer and Owner at least two weeks in advance.

3.3 START-UP SERVICE

A. The contractor shall provide the services of a qualified manufacturer representative to perform the following service duties.

1. Provide a minimum of one (1) day on-site services to provide installation instruction to the contractor on all aspects of equipment installation.

2. Provide a minimum of one (1) day of onsite startup services to provide a final system calibration, programming, and testing after completion of equipment installations.

B. Following completion of the above services, the supplier shall provide an affidavit to the facility, certifying that the system is installed and operating in accordance with the contract documents.

END OF SECTION

SECTION 26 0922 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Occupancy sensors.

B. In-wall time switches.

C. Outdoor photo controls.

1.2 RELATED REQUIREMENTS

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.

B. Section 26 0526 - Grounding and Bonding for Electrical Systems.

C. Section 26 0529 - Hangers and Supports for Electrical Systems.

D. Section 26 0537 - Boxes.

E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

F. Section 26 2726 - Wiring Devices: Devices for manual control of lighting, including wall switches.

1. Includes finish requirements for wall controls specified in this section.

G. Section 26 5100 - Interior Lighting.

H. Section 26 5600 - Exterior Lighting.

1.3 REFERENCE STANDARDS

A. 47 CFR 15 - Radio Frequency Devices; current edition.

B. ANSI C136.24 - American National Standard for Roadway and Area Lighting Equipment - Nonlocking (Button) Type Photocontrols; 2004 (R2010).

C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 773A - Nonindustrial Photoelectric Switches for Lighting Control; Current Edition, Including All Revisions.

G. UL 916 - Energy Management Equipment; Current Edition, Including All Revisions.

H. UL 917 - Clock-Operated Switches; Current Edition, Including All Revisions.

I. UL 1472 - Solid-State Dimming Controls; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. Final locations to be coordinated with the Engineer and Owner.

2. Coordinate placement of wall switch occupancy sensors with installed door swings.

3. Coordinate the placement of occupancy sensors with millwork, furniture, equipment or other potential obstructions to motion detection coverage.

4. Coordinate lighting control device product selections with luminaire characteristics; see Section 26 5100 and lighting fixture schedule.

5. Notify Engineer of conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

B. Sequencing:

1. Do not install lighting control devices until final surface finishes and painting are complete.

1.5 SUBMITTALS

A. Product Data: Include ratings, operating modes or sequence of functions, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.

1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.

B. Shop Drawings:

1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.

C. Field quality control reports.

D. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Operation and Maintenance Data: Include detailed information on device programming and setup.

F. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.6 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Maintain at project site one copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

D. Product Evaluation and Listing Organization Qualifications: Organization engaged in evaluation of products and services, including those recognized by OSHA as Nationally Recognized Testing Laboratories (NRTL), and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Store products in clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.8 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

A. Provide two year manufacturer warranty for all lighting control devices.

PART 2 - PRODUCTS

2.1 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for purpose intended.

B. Unless specifically indicated as excluded, provide components necessary for complete operating system including, but not limited to, conduit, wiring, connectors, hardware, and accessories.

2.2 OCCUPANCY SENSORS

A. Refer to Contract Drawings for Occupancy Sensor Schedule and Basis of design. All substitutions must be approved by the Engineer.

B. General Requirements:

1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small desktop level movements, according to published coverage areas, for automatic control of load indicated.

2. Sensor Technology as noted on the Drawings.

a. Passive Infrared (PIR) Occupancy Sensors: Designed to detect occupancy by sensing movement of thermal energy between zones.

b. Ultrasonic Occupancy Sensors: Designed to detect occupancy by sensing frequency shifts in emitted and reflected inaudible sound waves.

c. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using combination of both passive infrared and ultrasonic technologies.

3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.

4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.

5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.

6. Passive Infrared Lens Field of View: Field customizable by addition of factory masking material, adjustment of integral blinders, or similar means to block motion detection in selected areas.

7. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.

8. Sensitivity: Field adjustable.

9. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, LED lighting systems, fluorescent lighting with electronic and magnetic ballasts, and fractional motor loads, with no minimum load requirements.

10. Load Rating for Line Voltage Occupancy Sensors: As required to control load indicated on drawings.

11. Where wired sensors are indicated, wireless sensors are acceptable provided that components and wiring modifications necessary for proper operation are included.

12. Wireless Sensors:

    a. RF Range: 30 feet through typical construction materials.

    b. Electromagnetic Interference/Radio Frequency Interference (EMI/RFI) Limits: Comply with FCC requirements of 47 CFR 15, for Class B application.

    c. Power: Battery-operated with minimum ten-year battery life.

C. Wall Switch Occupancy Sensors:

1. General Requirements:

    a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with a field of view of 180 degrees, integrated manual control capability, and no leakage current to load in off mode.

    b. Unless otherwise indicated or required to control load indicated on drawings, provide line voltage units with self-contained relay.

    c. Where indicated, provide two-circuit units for control of two separate lighting loads, with separate manual controls and separately programmable operation for each load.

    d. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).

    e. Manual-Off Override Control: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.

    f. Finish: Match finishes specified for wiring devices in Section 26 2726, unless otherwise indicated.

D. Wall Dimmer Occupancy Sensors:

1. General Requirements:

    a. Description: Occupancy sensors designed for installation in standard wall box at standard wall switch mounting height with field of view of 180 degrees, integrated dimming control capability, and no leakage current to load in off mode.

    b. Operation: Field selectable to operate either as occupancy sensor (automatic on/off) or as vacancy sensor (manual-on/automatic off).

c. Manual-Off Override Control Capability: When used to turn off load while in automatic-on mode, unit to revert back to automatic mode after no occupant presence is detected during the delayed-off time interval.

d. Dimmer: Solid-state with continuous full-range even control following square law dimming curve, integral radio frequency interference filtering, power failure preset memory, air gap switch accessible without removing wall plate, and listed as complying with UL 1472; type and rating suitable for load controlled.

e. Provide field adjustable dimming preset for occupied state.

f. Provide fade-to-off operation to notify occupant of impending load turn-off.

g. Finish: Match finishes specified for wiring devices in Section 26 2726, unless otherwise indicated.

E. Ceiling Mounted Occupancy Sensors:

1. General Requirements:

a. Description: Low profile occupancy sensors designed for ceiling installation.

b. Unless otherwise indicated or required to control load indicated on drawings, provide low voltage units, for use with separate compatible accessory power packs.

c. Provide field selectable setting for disabling LED motion detector visual indicator.

d. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.

e. Finish: White unless otherwise indicated.

F. Power Packs for Low-Voltage Occupancy Sensors:

1. Description: Plenum rated, self-contained low voltage class 2 transformer and relay compatible with specified low voltage occupancy sensors for switching of line voltage loads.

2. Provide quantity and configuration of power and slave packs with associated wiring and accessories as required to control load indicated on drawings.

3. Input Supply Voltage: Dual rated for 120/277 V ac.

4. Load Rating: As required to control the load indicated on drawings.

G. Power Packs for Wireless Occupancy Sensors:

1. Description: Plenum rated, self-contained relay compatible with specified wireless occupancy sensors for switching of line voltage loads.

2. Input Supply Voltage: Dual rated for 120/277 V ac.

2.3 IN-WALL TIME SWITCHES

A. Manufacturers:

1. Wattstopper.

2. Intermatic, Inc: www.intermatic.com/#sle.

3. NSI Industries LLC: www.nsiindustries.com/#sle.

B. Digital Electronic In-Wall Time Switches:

1. Description: Factory-assembled solid state programmable controller with LCD display, suitable for mounting in standard wall box, and listed and labeled as complying with UL 916 or UL 917.

2. Program Capability:

a. Astronomic Time Switches: Capable of different schedule for each day of the week and field-configurable astronomic feature to automatically adjust for seasonal changes in sunrise and sunset times.

3. Provide power outage backup to retain programming and maintain clock.

4. Manual override: Capable of overriding current schedule both permanently and temporarily until next scheduled event.

5. Switch Configuration: Suitable for use in either SPST or 3-way application.

6. Contact Ratings: As required to control the load indicated on drawings.

2.4 OUTDOOR PHOTO CONTROLS

A. Manufacturers:

1. Intermatic, Inc: www.intermatic.com/#sle.

B. Stem-Mounted Outdoor Photo Controls:

1. Description: Direct-wired photo control unit with threaded conduit mounting stem and field-adjustable swivel base, listed and labeled as complying with UL 773A.

2. Housing: Weatherproof, impact resistant polycarbonate.

3. Photo Sensor: Cadmium sulfide.

4. Provide external sliding shield for field adjustment of light level activation.

5. Light Level Activation: 1 to 5 footcandles turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.

6. Voltage: As required to control the load indicated on the drawings.

7. Failure Mode: Fails to the on position.

8. Load Rating: As required to control the load indicated on the drawings.

9. Provide accessory wall-mounting bracket where indicated or as required to complete installation.

C. Button Type Outdoor Photo Controls

1. Description: Direct-wired photo control unit complying with ANSI C136.24 with weatherproof gasketed wall plate where required or indicated, listed and labeled as complying with UL 773A.

2. Housing: Weather resistant polycarbonate.

3. Photo Sensor: Cadmium sulfide.

4. Light Level Activation: 1 to 3 footcandles turn-on and 3 to 1 turn-off to turn-on ratio with delayed turn-off.

5. Voltage: As required to control the load indicated on the drawings.

6. Failure Mode: Fails to the on position.

7. Load Rating: As required to control the load indicated on the drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.

F. Verify that service voltage and ratings of lighting control devices are appropriate for service voltage and load requirements at location to be installed.

G. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

A. Install lighting control devices in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of lighting control devices provided under this section. Final locaitons to be coordianted with the owner and architect.

1. Mounting Heights: Unless otherwise indicated, as follows:

    a. Wall Switch Occupancy Sensors: 48 inches above finished floor.

    b. In-Wall Time Switches: 48 inches above finished floor.

2. Orient outlet boxes for vertical installation of lighting control devices unless otherwise indicated.

C. Maintain separation of remote-control, signaling, and power-limited circuits.

1. See manufacturer instructions and Section 26 0519 for control wiring conductors, wiring methods, and identification requirements.

D. Install lighting control devices in accordance with manufacturer's instructions.

E. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

F. Install lighting control devices plumb and level, and held securely in place.

G. Where required and not furnished with lighting control device, provide wall plate; see Section 26 2726.

H. Provide required supports; see Section 26 0529.

I. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

J. Identify lighting control devices; see Section 26 0553.

K. Occupancy Sensor Locations:

1. Location Adjustments: Within the design intent, reasonably minor adjustments to locations may be made in order to optimize coverage and avoid conflicts or problems affecting coverage.

2. Location Adjustments: Locations indicated are diagrammatic and only intended to indicate which rooms or areas require devices. Provide quantity and locations as required for complete coverage of respective room or area based on manufacturer's recommendations for installed devices.

3. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors minimum of 4 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.

L. Outdoor Photo Control Locations:

1. Where possible, locate outdoor photo controls with photo sensor facing north. If north facing photo sensor is not possible, install with photo sensor facing east, west, or down.

2. Locate outdoor photo controls so that photo sensors do not face artificial light sources, including light sources controlled by photo control itself.

M. Install outdoor photo controls so that connections are weatherproof. Do not install photo controls with conduit stem facing up in order to prevent infiltration of water into photo control.

N. Unless otherwise indicated, install power packs for lighting control devices above accessible ceiling or above access panel in inaccessible ceiling near sensor location.

O. Where indicated, install separate compatible wall switches for manual control interface with lighting control devices or associated power packs.

P. Unless otherwise indicated, install switches on load side of power packs so that switch does not turn off power pack.

3.4 FIELD QUALITY CONTROL

A. Inspect each lighting control device for damage and defects.

B. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.

C. Test time switches to verify proper operation.

D. Test outdoor photo controls to verify proper operation, including time delays where applicable.

E. Correct wiring deficiencies and replace damaged or defective conductors, cables, and lighting control devices.

3.5 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Engineer.

C. Adjust time switch settings to achieve desired operation schedule as indicated or as directed by Engineer. Record settings in written report to be included with submittals.

D. Adjust external sliding shields on outdoor photo controls under optimum lighting conditions to achieve desired turn-on and turn-off activation as indicated or as directed by Engineer.

3.6 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.7 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of lighting control devices to Engineer, and correct deficiencies or make adjustments as directed.

B. Training: Train Owner's personnel on operation, adjustment, programming, and maintenance of lighting control devices.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

2. Provide minimum of four hours of training.

3. Instructor: Manufacturer's authorized service representative.

4. Location: At project site.

END OF SECTION

SECTION 26 2100 - LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electrical service requirements.

1.2 RELATED REQUIREMENTS

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.

B. Section 26 0526 - Grounding and Bonding for Electrical Systems.

C. Section 26 0529 - Hangers and Supports for Electrical Systems.

D. Section 26 0534 - Conduit.

E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

F. Section 26 2413 - Switchboards: Service entrance equipment.

G. Section 26 2416 - Panelboards: Service entrance equipment.

H. Section 26 2818 - Enclosed Switches: Service entrance equipment.

I. Section 26 3213 - Engine Generators: Emergency/standby power systems for interconnection with normal utility electrical supply.

J. Section 26 3600 - Transfer Switches: Service entrance equipment.

K. Section 26 4300 - Surge Protective Devices: Service entrance surge protective devices.

1.3 DEFINITIONS

A. Service Point: The point of connection between the facilities of the serving utility and the premises wiring as defined in NFPA 70, and as designated by the Utility Company.

1.4 REFERENCE STANDARDS

A. IEEE C2 - National Electrical Safety Code; 2012.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.5 ADMINISTRATIVE REQUIREMENTS

A. No later than two weeks following date of the Agreement, notify Utility Company of anticipated date of service.

B. Coordination:

1. Verify the following with Utility Company representative:

a. Utility Company requirements, including division of responsibility.

b. Exact location and details of utility point of connection.

c. Utility easement requirements.

d. Utility Company charges associated with providing service.

2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for electrical service and associated equipment.

3. Coordinate arrangement of service entrance equipment with the dimensions and clearance requirements of the actual equipment to be installed.

4. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

C. Arrange for Utility Company to provide permanent electrical service. Prepare and submit documentation required by Utility Company.

D. Utility Company charges associated with providing permanent service to be paid by Owner, outside of this contract.

E. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details with Utility Company representative.

F. Scheduling:

1. Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner.

2. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.6 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product. Include ratings, configurations, standard wiring diagrams, outline and support point dimensions, finishes, weights, service condition requirements, and installed features.

B. Shop Drawings: Include dimensioned plan views and sections indicating locations and arrangement of Utility Company and service entrance equipment, metering provisions, required clearances, and proposed service routing.

1. Obtain Utility company approval of shop drawings prior to submittal.

a. Contractor to submit proposed/specified primary cable to the Utility for approval prior to purchase.

C. Drawings prepared by Utility Company.

D. Project Record Documents: Record actual locations of equipment and installed service routing.

1.7 QUALITY ASSURANCE

A. Comply with the following:

1. IEEE C2 (National Electrical Safety Code).

2. NFPA 70 (National Electrical Code).

3. The requirements of the Utility Company.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Products: Listed, classified, and labeled as suitable for the purpose intended.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

B. Store products indoors in a clean, dry space having a uniform temperature to prevent condensation (including outdoor rated products which are not weatherproof until completely and properly installed). Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle products carefully to avoid damage to internal components, enclosure, and finish.

PART 2 - PRODUCTS

2.1 ELECTRICAL SERVICE REQUIREMENTS

A. Provide new electrical service consisting of all required conduits, conductors, equipment, metering provisions, supports, accessories, etc. as necessary for connection between Utility Company point of supply and service entrance equipment.

B. Refer to the Contract Drawings for utility contact information and work order number.

C. Electrical Service Characteristics: As indicated on the contract drawings.

D. Division of Responsibility: As indicated on the Contract Drawings and as required by the Utility Company Standards and applicable codes..

E. Products Furnished by Contractor: Comply with Utility Company requirements and all applicable codes/regulations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that ratings and configurations of service entrance equipment are consistent with the indicated requirements.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Verify and mark locations of existing underground utilities.

3.3 INSTALLATION

A. Install products in accordance with manufacturer's instructions and Utility Company requirements.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances and required maintenance access.

D. Provide required trenching and backfilling as indicated on the Contract Drawings.

E. Provide required protective bollards in accordance with Utility Company requirements.

F. Provide required support and attachment components in accordance with Section 26 0529.

G. Provide grounding and bonding for service entrance equipment in accordance with Section 26 0526.

H. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 26 0553.

3.4 PROTECTION

A. Protect installed equipment from subsequent construction operations.

END OF SECTION

SECTION 26 2200 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. General purpose transformers.

1.2 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 0534 - Conduit: flexible conduit connections.

D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

E. Section 26 2419 - Motor Control Centers

1.3 REFERENCE STANDARDS

A. 10 CFR 431, Subpart K - Energy Efficiency Program for Certain Commercial and Industrial Equipment - Distribution Transformers; Current Edition.

B. IEEE C57.94 - IEEE Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type General Purpose Distribution and Power Transformers; 1982 (R2006).

C. IEEE C57.96 - Guide for Loading Dry-Type Distribution and Power Transformers; 2013.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

E. NECA 409 - Standard for Installing and Maintaining Dry-Type Transformers; 2009.

F. NEMA ST 20 - Dry-Type Transformers for General Applications; 2014.

G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.

I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. UL 506 - Standard for Specialty Transformers; Current Edition, Including All Revisions.

K. UL 1561 - Standard for Dry-Type General Purpose and Power Transformers; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

3. Coordinate the work with placement of supports, anchors, etc. required for mounting.

4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.

5. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. Product Data: Include voltage, kVA, impedance, tap configurations, insulation system class and rated temperature rise, efficiency, sound level, enclosure ratings, outline and support point dimensions, weight, required clearances, service condition requirements, and installed features.

B. Shop Drawings: Provide dimensioned plan and elevation views of transformers and adjacent equipment with all required clearances indicated.

C. Source Quality Control Test Reports: Include reports for tests designated in NEMA ST 20 as design and routine tests.

D. Field Quality Control Test Reports.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Maintenance Data: Include recommended maintenance procedures and intervals.

G. Project Record Documents: Record actual locations of transformers.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

1.8 WARRANTY

A. After equipment is installed and operational, the Contractor shall furnish a two-year warranty against defects in material and workmanship. Warranty coverage shall include all parts, labor, and travel expenses.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Eaton Corporation: www.eaton.com.

B. Source Limitations: Furnish transformers produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

1. To clarify, all power distribution equipment (panelboards, transformers, safety switches, controllers, etc.) as part of this Contract shall be produced by a single manufacturer and supplied by a single supplier.

2.2 TRANSFORMERS - GENERAL REQUIREMENTS

A. Description: Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with NEMA ST 20 and listed, classified, and labeled as suitable for the purpose intended.

B. Unless noted otherwise, transformer ratings indicated are for continuous loading according to IEEE C57.96 under the following service conditions:

1. Altitude: Less than 3,300 feet.

2. Ambient Temperature:

    a. Greater than 10 kVA: Not exceeding 104 degrees F.

    b. Less than 10 kVA: Not exceeding 77 degrees F.

C. Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.

D. Impregnate core and coil assembly with non-hydroscopic thermo-setting varnish to effectively seal out moisture and other contaminants.

E. Basic Impulse Level: 10 kV.

F. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

G. Isolate core and coil from enclosure using vibration-absorbing mounts.

H. Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.

2.3 GENERAL PURPOSE TRANSFORMERS

A. Refer to transformer schedule on Contract Drawings.

B. Description: Self-cooled, two winding transformers listed and labeled as complying with UL 506 or UL 1561; ratings as indicated on the drawings.

C. Insulation System and Allowable Average Winding Temperature Rise:

1. Less than 15 kVA: Class 180 degrees C insulation system with 80 degrees C average winding temperature rise.

2. 15 kVA and Larger: Class 220 degrees C insulation system with 115 degrees C average winding temperature rise.

D. Coil Conductors: Continuous copper windings with terminations brazed or welded.

E. Winding Taps:

1. Less than 3 kVA: None.

2. 3 kVA through 15 kVA: None.

3. 15 kVA through 300 kVA: Refer to the Contract Drawings Transformer Schedule.

4. 500 kVA and Larger: Two 2.5 percent full capacity primary taps above and two 2.5 percent full capacity primary taps below rated voltage.

F. Energy Efficiency: Comply with 10 CFR 431, Subpart K.

G. Sound Levels: Standard sound levels complying with NEMA ST 20.

H. Mounting Provisions:

1. Refer to the Contract Drawings and to the below mounting provisions.

a. Less than 15 kVA: Suitable for wall mounting.

b. 15 kVA through 75 kVA: Suitable for wall, floor, or trapeze mounting.

1) Provide a 4" concrete house keeping pad as indicated on the Contract Drawings.

c. Larger than 75 kVA: Suitable for floor mounting.

1) Provide a 4" concrete house keeping pad as indicated on the Contract Drawings.

I. Transformer Enclosure: Comply with NEMA ST 20. Provide with enclosure type (NEMA Rating) per the contract drawings transformer schedule unless otherwise indicated.

1. Environment Type per NEMA 250: As indicated on the drawings.

2. Construction: Steel.

a. Less than 15 kVA: Totally enclosed, non-ventilated.

b. 15 kVA and Larger: Ventilated.

3. Finish: Manufacturer's standard grey, suitable for outdoor or indoor installations.

4. Provide lifting eyes or brackets.

J. Accessories:

1. Mounting Brackets: Provide manufacturer's standard brackets.

2. Weathershield Kits: Provide for ventilated transformers installed outdoors to provide a listed NEMA 250, type 3R assembly.

3. Lug Kits: Sized as required for termination of conductors as indicated on the drawings.

2.4 SOURCE QUALITY CONTROL

A. Factory test transformers according to NEMA ST 20.

B. Sound Level Tests: Perform factory test designated in NEMA ST 20 as "design" test on each production unit.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that suitable support frames and anchors are installed where required and that mounting surfaces are ready to receive transformers.

C. Perform pre-installation tests and inspections on transformers per manufacturer's instructions and as specified in NECA 409. Correct deficiencies prior to installation.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install transformers in accordance with NECA 409 and IEEE C57.94.

D. Use flexible conduit, under the provisions of Section 26 0534, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

E. Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and NFPA 70.

F. Install transformers plumb and level.

G. Transformer Support:

1. Provide required support and attachment in accordance with Section 26 0529, where not furnished by transformer manufacturer.

2. Use integral transformer flanges, accessory brackets furnished by manufacturer, or field-fabricated supports to support wall-mounted transformers.

3. Use trapeze hangers assembled from threaded rods and metal channel (strut) to support suspended transformers. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.

H. Mount floor-mounted transformers on properly sized 4 inch (100 mm) high concrete pad as indicated on the Contract Drawings.

I. Provide grounding and bonding in accordance with Section 26 0526.

J. Remove shipping braces and adjust bolts that attach the core and coil mounting bracket to the enclosure according to manufacturer's recommendations in order to reduce audible noise transmission.

K. Where not factory-installed, install lugs sized as required for termination of conductors as indicated.

L. Where furnished as a separate accessory, install transformer weathershield per manufacturer's instructions.

M. Identify transformers in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

3.4 ADJUSTING

A. Measure primary and secondary voltages and make appropriate tap adjustments.

B. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

A. Clean dirt and debris from transformer components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 2413 - SWITCHBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Low-voltage (600 V and less) switchboards and associated accessories for service and distribution applications.

B. Overcurrent protective devices for switchboards.

1.2 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 26 0573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

E. Section 26 2100 - Low-Voltage Electrical Service Entrance.

F. Section 26 3600 Transfer Switches

G. Section 26 2419 - Motor-Control Centers.

H. Section 26 4300 - Surge Protective Devices.

1.3 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; Federal Specification; Revision E, 2013.

B. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2008.

C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

D. NECA 400 - Standard for Installing and Maintaining Switchboards; 2007.

E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

F. NEMA PB 2 - Deadfront Distribution Switchboards; 2011.

G. NEMA PB 2.1 - General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards Rated 600 Volts or Less; 2013.

H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.

I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

J. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

K. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

L. UL 891 - Switchboards; Current Edition, Including All Revisions.

M. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.

4. Coordinate with manufacturer to provide shipping splits suitable for the dimensional constraints of the installation.

5. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Service Entrance Switchboards:

1. Coordinate with Utility Company to provide switchboards with suitable provisions for electrical service and utility metering, where applicable.

2. Coordinate with Owner to arrange for Utility Company required access to equipment for installation and maintenance.

3. Obtain Utility Company approval of switchboard prior to fabrication.

4. Preinstallation Meeting: Convene one week prior to commencing work of this section to review requirements with Utility Company representative.

5. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.5 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for switchboards, enclosures, overcurrent protective devices, and other installed components and accessories.

1. Include characteristic trip curves for each type and rating of overcurrent protective device.

B. Shop Drawings: Indicate dimensions, voltage, bus ampacities, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

1. Include dimensioned plan and elevation views of switchboards and adjacent equipment with all required clearances indicated.

2. Include wiring diagrams showing all factory and field connections.

C. Service Entrance Switchboards: Include documentation of Utility Company approval of switchboard.

D. Source Quality Control Test Reports: Include reports for tests designated in NEMA PB 2 as design (type) and production (routine) tests.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Field Quality Control Test Reports.

G. Project Record Documents: Record actual installed locations of switchboards and final equipment settings.

H. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Enclosure Keys: Two of each different key.

2. Electronic Trip Circuit Breakers: Provide one portable test set as part of the Switchboard package.

a. Note, portable test set to be used throughout project for testing of electronic trip circuit breakers.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store switchboards in accordance with manufacturer's instructions, NECA 400, and NEMA PB 2.1.

B. Store in a clean, dry space having a uniform temperature to prevent condensation (including outdoor switchboards, which are not weatherproof until completely and properly installed). Where necessary, provide temporary enclosure space heaters or temporary power for permanent factory-installed space heaters.

C. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

A. Maintain field conditions within required service conditions during and after installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Switchboards - Basis of Design: Eaton.

B. Source Limitations: Furnish switchboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

1. To clarify, all power distribution equipment (switchboard, panelboards, transformers, safety switches, etc.) as part of this Contract shall be produced by a single manufacturer and supplied by a single supplier.

2.2 SWITCHBOARDS

A. Provide switchboards consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Description: Dead-front switchboard assemblies complying with NEMA PB 2, and listed and labeled as complying with UL 891; ratings, configurations and features as indicated on the drawings.

D. Front-Connected Switchboards:

1. Main Device(s): Individually-mounted.

2. Feeder Devices: Panel/group-mounted.

3. Arrangement: Front accessible only (not rear accessible), rear aligned.

4. Gutter Access: Bolted covers.

E. Service Entrance Switchboards:

1. Listed and labeled as suitable for use as service equipment according to UL 869A.

2. For solidly-grounded wye systems, provide factory-installed main bonding jumper between neutral and ground busses, and removable neutral disconnecting link for testing purposes.

3. Comply with Utility Company requirements for electrical service.

F. Service Conditions:

1. Provide switchboards and associated components suitable for operation under the following service conditions without derating:

a. Altitude: Less than 6,600 feet.

b. Ambient Temperature:

1) Switchboards Containing Molded Case or Insulated Case Circuit Breakers: Between 23 degrees F and 104 degrees F.

2. Provide switchboards and associated components suitable for operation at indicated ratings under the service conditions at the installed location.

G. Short Circuit Current Rating:

1. Provide switchboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

2. Minimum Rating: 65,000 rms symmetrical amperes.

H. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

I. Main Devices: Configure for top or bottom incoming feed as indicated or as required for the installation (Contractor to field verify and advise manufacturer prior to release of order). Provide separate pull section and/or top-mounted pullbox as indicated or as required to facilitate installation of incoming feed.

J. Bussing: Sized in accordance with UL 891 temperature rise requirements.

1. Through bus (horizontal cross bus) to be fully rated through full length of switchboard (non-tapered). Tapered bus is not permitted.

2. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.

3. Provide solidly bonded equipment ground bus through full length of switchboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

4. Phase and Neutral Bus Material: Copper.

5. Ground Bus Material: Copper.

K. Conductor Terminations: Suitable for use with the conductors to be installed.

1. Line Conductor Terminations:

a. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

b. Main and Neutral Lug Type: Mechanical.

2. Load Conductor Terminations:

a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

b. Lug Type:

1) Provide mechanical lugs unless otherwise indicated.

L. Enclosures:

1. Environment Type per NEMA 250: As indicated on the drawings.

2. Finish: Manufacturer's standard unless otherwise indicated.

M. Future Provisions:

1. Prepare designated spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

2. Equip distribution sections with full height vertical bussing to accommodate maximum utilization of space for devices.

3. Where designated spaces for future device provisions are not indicated on the Contract Drawings, include provisions for minimum of 4 device(s) rated at 225 amperes.

N. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 26 4300, list switchboards as a complete assembly including surge protective device.

O. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.

1. Where overcurrent protective devices equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.

P. Arc Flash Energy-Reducing Maintenance Switching: For circuit breakers rated 1200 A or higher, provide a local accessory switch with status indicator light that permits selection of a maintenance mode with alternate electronic trip unit settings for reduced fault clearing time.

Q. Owner Metering:

1. Provide microprocessor-based digital electrical metering system including all instrument transformers, wiring, and connections necessary for measurements specified. Refer to Contract Drawings for basis of design information.

2. Features:

a. Ethernet Compatible

R. Instrument Transformers:

1. Comply with IEEE C57.13.

2. Select suitable ratio, burden, and accuracy as required for connected devices.

3. Current Transformers: Connect secondaries to shorting terminal blocks.

4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

2.3 OVERCURRENT PROTECTIVE DEVICES

A. Circuit Breakers:

1. Interrupting Capacity:

    a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.

    b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.

2. Molded Case Circuit Breakers:

    a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers; listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.

        1) Provide thermal magnetic circuit breakers for circuit breaker frame sizes less than 225 amperes.

        2) Provide electronic trip circuit breakers for circuit breaker frame sizes 225 amperes and above.

    b. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.

        1) Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 100 amperes and larger.

        2) Provide interchangeable trip units where indicated.

    c. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units on all circuit breakers 225 amps and larger and as indicated on the Contract Drawings.

        1) Provide the following field-adjustable trip response settings:

            (a) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.

            (b) Long time delay.

            (c) Short time pickup and delay.

            (d) Instantaneous pickup.

            (e) Ground fault pickup and delay where ground fault protection is indicated.

    d. Provide the following circuit breaker types where indicated:

1) 100 Percent Rated Circuit Breakers: Listed for application within the switchboard where installed at 100 percent of the continuous current rating.

e. Provide the following features and accessories where indicated or where required to complete installation:

1) Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.

2) Pad-Lock Provision: For locking circuit breaker handle in OFF position.

3) Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.

4) Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.

5) Alarm Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped.

2.4 SOURCE QUALITY CONTROL

A. Factory test switchboards according to NEMA PB 2, including the following production (routine) tests on each switchboard assembly or component:

1. Dielectric tests.

2. Mechanical operation tests.

3. Grounding of instrument transformer cases test.

4. Electrical operation and control wiring tests, including polarity and sequence tests.

5. Ground-fault sensing equipment test.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of the switchboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive switchboards.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install switchboards in accordance with NECA 1 (general workmanship), NECA 400, and NEMA PB 2.1.

C. Arrange equipment to provide required clearances and maintenance access, including accommodations for any drawout devices.

D. Where switchboard is indicated to be mounted with inaccessible side against wall, provide minimum clearance of 1/2 inch between switchboard and wall.

E. Provide required support and attachment in accordance with Section 26 0529.

F. Install switchboards plumb and level.

G. Unless otherwise indicated, mount switchboards on properly sized 4 inch high concrete pad constructed in accordance with specifications.

H. Provide grounding and bonding in accordance with Section 26 0526.

I. Install all field-installed devices, components, and accessories.

J. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

K. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed in accordance with Section 26 0573.

    1. Settings to be field applied by certified manufacturer representative during equipment startup.

L. Set field-adjustable ground fault protection pickup and time delay settings as determined by overcurrent protective device coordination study performed in accordance with Section 26 0573.

    1. Settings to be field applied by certified manufacturer representative during equipment startup.

M. Provide filler plates to cover unused spaces in switchboards.

N. Identify switchboards in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

A. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's reports with submittals.

1. Assume 2-days of on-site manufacturer services to observe the installation and assist in inspection/testing.

B. Provide manufacturer authorized representative to apply circuit breaker settings per results of specified power system analysis.

1. Assume 1-day of on-site manufacturer services to apply circuit breaker settings.

C. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

D. Before energizing switchboard, perform insulation resistance testing in accordance with NECA 400 and NEMA PB 2.1.

E. Inspect and test in accordance with NETA ATS, except Section 4.

F. Perform inspections and tests listed in NETA ATS, Section 7.1.

G. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 400 amperes. Tests listed as optional are not required.

H. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.

1. Perform inspections and tests listed in NETA ATS, Section 7.14. The insulation-resistance test on control wiring listed as optional is not required.

I. Meters: Perform inspections and tests listed in NETA ATS, Section 7.11.2.

J. Instrument Transformers: Perform inspections and tests listed in NETA ATS, Section 7.10. The dielectric withstand tests on primary windings with secondary windings connected to ground listed as optional are not required.

K. Correct deficiencies and replace damaged or defective switchboards or associated components.

L. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.4 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of switchboard covers and doors.

3.5 CLEANING

A. Clean dirt and debris from switchboard enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred surfaces to match original factory finish.

3.6 CLOSEOUT ACTIVITIES

A. Training: Train Owner's personnel on operation, adjustment, and maintenance of switchboard and associated devices.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

2. Provide minimum of 4 hours of training.

3. Instructor: Manufacturer's authorized representative.

4. Location: At project site.

3.7 PROTECTION

A. Protect installed switchboards from subsequent construction operations.

END OF SECTION

SECTION 26 2416 - PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Power distribution panelboards.

B. Overcurrent protective devices for panelboards.

1.2 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 26 0573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

E. Section 26 4300 - Surge Protective Devices.

1.3 REFERENCE STANDARDS

A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; Federal Specification; Revision E, 2013.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2009.

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

E. NEMA PB 1 - Panelboards; 2011.

F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less; 2013.

G. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.

H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

K. UL 67 - Panelboards; Current Edition, Including All Revisions.

L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

M. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

N. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

O. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.

P. UL 1699 - Arc-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.

4. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.

1. Include characteristic trip curves for each type and rating of overcurrent protective device.

B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.

2. Include wiring diagrams showing all factory and field connections.

3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.

C. Source Quality Control Test Reports: Include reports for tests designated in NEMA PB 1 as routine tests.

D. Field Quality Control Test Reports.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.

G. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Panelboard Keys: Two of each different key.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

A. Maintain ambient temperature within the following limits during and after installation of panelboards:

1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Eaton Corporation; Cutler-Hammer Products. : www.eaton.com.

B. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

1. To clarify, all power distribution equipment (panelboards, transformers, safety switches, controllers, etc.) as part of this Contract shall be produced by a single manufacturer and supplied by a single supplier.

2.2 PANELBOARDS - GENERAL REQUIREMENTS

A. Provide products listed, classified, and labeled as suitable for the purpose intended. Refer to the Contract Drawings for additional information.

B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:

1. Altitude: Less than 6,600 feet.

2. Ambient Temperature:

a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

C. Short Circuit Current Rating:

1. Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

D. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

E. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.

F. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.

G. Bussing: Sized in accordance with UL 67 temperature rise requirements.

1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.

2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.

3. Provide separate isolated/insulated ground bus where indicated or where isolated grounding conductors are provided.

H. Conductor Terminations: Suitable for use with the conductors to be installed.

I. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.

1. Environment Type per NEMA 250: As indicated on the drawings.

2. Boxes: Galvanized steel unless otherwise indicated.

a. Provide wiring gutters sized to accommodate the conductors to be installed.

b. Increase gutter space as required where sub-feed lugs, feed-through lugs, gutter taps, or oversized lugs are provided.

3. Fronts:

a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.

b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.

c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.

4. Lockable Doors: All locks keyed alike unless otherwise indicated.

J. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

K. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 26 4300, list and label panelboards as a complete assembly including surge protective device.

L. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.

1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.

M. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

N. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.

O. Load centers are not acceptable unless specifically specified on the Contract Drawings.

P. Provide the following features and accessories where indicated or where required to complete installation:

1. Feed-through lugs.

2. Sub-feed lugs.

2.3 POWER DISTRIBUTION PANELBOARDS

A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations:

1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

2. Main and Neutral Lug Type: Mechanical.

C. Bussing:

1. Phase and Neutral Bus Material: Copper.

2. Ground Bus Material: Copper.

D. Circuit Breakers:

1. Provide bolt-on type.

2. Provide thermal magnetic circuit breakers for circuit breaker frame sizes less than 225 amperes.

3. Provide electronic trip (LSI) circuit breakers for circuit breaker frame sizes 225 amperes and above.

E. Enclosures:

1. Provide surface-mounted enclosures unless otherwise indicated.

2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.

3. Provide clear plastic circuit directory holder mounted on inside of door.

    a. Provide typed circuit directory for all proposed panelboards and panelboards in which have had circuit modifications performed. Circuit directories to be labeled with equipment type (not the equipment tag) as indicated on the equipment connection schedule on the contract drawings. Coordinate final labeling requirements with the engineer/owner.

2.4 OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breakers:

1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.

2. Interrupting Capacity:

    a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating as indicated on the Contract Drawings

    b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.

3. Conductor Terminations:

    a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.

    a. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 100 amperes and larger, unless otherwise noted.

5. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units for any circuit breakers rated 225A and larger, unless otherwise noted/indicated on the Contract Drawings.

    a. Provide the following field-adjustable trip response settings:

        1) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.

2) Long time delay.

3) Short time pickup and delay.

4) Instantaneous pickup.

5) Ground fault pickup and delay where ground fault protection is indicated.

6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.

7. Provide the following circuit breaker types where indicated:

   a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.

   b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.

   c. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Combination type listed as complying with UL 1699.

   d. 100 Percent Rated Circuit Breakers: Listed for application within the panelboard where installed at 100 percent of the continuous current rating.

8. Provide listed switching duty rated circuit breakers with SWD marking where indicated.

9. Do not use handle ties in lieu of multi-pole circuit breakers.

10. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.

11. Provide the following features and accessories where indicated or where required to complete installation:

    a. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.

    b. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.

    c. Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.

2.5 SOURCE QUALITY CONTROL

A. Factory test panelboards according to NEMA PB 1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive panelboards.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.

D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

E. Provide required support and attachment in accordance with Section 26 0529.

F. Install panelboards plumb.

G. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.

H. Mount floor-mounted power distribution panelboards on properly sized 4 inch (80 mm) high concrete pad.

I. Provide grounding and bonding in accordance with Section 26 0526.

1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.

2. Terminate branch circuit isolated grounding conductors on isolated/insulated ground bus only. Do not terminate on solidly bonded equipment ground bus.

J. Install all field-installed branch devices, components, and accessories.

K. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed according to Section 26 0573. Settings to be field applied during equipment startup by certified manufacturer representative.

L. Set field-adjustable ground fault protection pickup and time delay settings as indicated.

M. Provide filler plates to cover unused spaces in panelboards.

N. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated.

O. Identify panelboards in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 400 amperes. Tests listed as optional are not required.

C. Test GFCI circuit breakers to verify proper operation.

D. Test AFCI circuit breakers to verify proper operation.

E. Test shunt trips to verify proper operation.

F. Procure services of a qualified manufacturer's representative to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's reports with field quality control submittals.

G. Certified manufacturer repreentative to provide equipment startup services, inspect equipment installation, adjust overcurrent protective device settings (per results of section 26 05 73), and provide operator training.

    1. Include one (1) 8-hour day at the project site to provide above listed services.

H. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.4 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

B. Adjust alignment of panelboard fronts.

C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.5 CLEANING

A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 2419 - MOTOR CONTROL CENTERS

PART 1 GENERAL

1.1 SCOPE

A. This section includes the requirements for 600V-class low voltage motor control centers (MCCs) for use on alternating current power systems.

B. The MCCs shall be furnished and installed as specified in this section and as shown on the contract drawings.

C. Provide one (1) 8-hour meeting with the engineer prior to submitting submittal package to coordinate MCC bucket elementary wiring diagrams/requirements. Meeting to be virtual.

1.2 RELATED SECTIONS

A. Section 26 29 13 Enclosed Controllers - Across the Line Motor Controllers.

B. Section 26 29 23 Variable Frequency Drives.

1.3 REFERENCES

A. The MCC shall meet or exceed the requirements within the following standards for MCCs.

1. NEMA ICS 18 - Industrial Control and Systems: Motor Control Centers

2. UL 845 - UL Standard for Safety for Motor Control Centers NOTE: UL 845 is a harmonized standard consisting of:

a. Underwriters Laboratories Inc. (UL) UL 845

b. Canadian Standards Association (CSA) C22.2 No. 254-05

c. Association of Standardization and Certification (ANCE) NMX-J-353-ANCE-2006

3. NFPA 70 - National Electrical Code

B. The MCC shall be designed, manufactured, and tested in facilities registered to ISO 9001.

1.4 DESIGN REQUIREMENTS

A. Provide MCC based on applicable NEMA and UL standards and in accordance with the detailed contract specifications and drawings.

B. The manufacturer of the MCC shall also be the manufacturer of the across-the-line motor starters, across-the-line contactors, solid-state reduced voltage starters, and variable

frequency drives. The use of third-party supply and assembly for these components in the motor control center is not acceptable.

C. The contractor shall confirm motor full-load amperage ratings and provide those ratings to the MCC manufacturer to achieve proper sizing of the drives, soft starters, motor branch circuit, and overload protection.

1.5 PRE-MANUFACTURE SUBMITTALS

A. Manufacturer Drawings.

1. MCC elevations showing dimensional information including details such as, but not limited to, the following:
    a. MCC height (less any removable lifting angles or eyes)
    b. MCC width
    c. MCC depth
    d. Location of shipping splits
2. Structure descriptions showing the following:
    a. Bus ratings
    b. Enclosure ratings
    c. Short-circuit withstand ratings
    d. Other information as required for approval
3. Conduit locations
4. Required bus splices
5. Unit descriptions including information such as, starter sizes, circuit breaker frame sizes, circuit-breaker continuous ampere ratings, and pilot devices
6. Nameplate information
7. Schematic wiring diagrams
8. Manufacturer drawings shall be provided in PDF format
9. Manufacturer drawings do not need to be stamped if a drawing schedule is provided that lists the drawing numbers, version levels, and status of drawings (such as, preliminary, approval, and final)

B. Product Data.

1. Data sheets and publications on all major components including, but not limited to, the following:

    a. Motor starters and VFDs

    b. Overload relays

    c. Circuit breaker and fuse information including time current characteristics

    d. Control power transformers

    e. Pilot devices

    f. Relays

C. Specification Response.

1. All clarifications and exceptions must be clearly identified

D. Installation Instructions.

1. Provide a copy of the manufacturer's installation instructions that includes the following:

    a. Receiving, handling, and storage instructions

    b. General description for reading nameplate data, serial numbers, UL markings, and short circuit ratings

    c. Installation procedures including splicing procedures

    d. Conduit and cable installation

    e. Installing and removing plug-in units

    f. Operation of operator handles and unit interlocks

    g. Checklist before energizing

    h. Procedure for energizing equipment

    i. Maintenance procedures

1.6 FINAL SUBMITTALS

A. The contractor shall provide certification that the MCC has been installed in accordance with the manufacturer's instructions and with local codes and standards that govern MCC installations.

B. The contractor shall provide certification that all circuit breaker settings have been adjusted per field requirements.

C. The contractor shall provide certification that all power fuses have been selected and installed per field requirements.

D. The contractor shall provide certification that all solid-state motor overload settings have been adjusted per installed motor characteristics.

E. The contractor shall provide certification that all settings for solid state devices such as reduced voltage solid-state controllers and variable frequency drives have been adjusted per the specific application requirements.

F. The contractor shall provide certification that any timing devices have been properly adjusted.

G. As Shipped Drawings.

1. The manufacturer shall provide final drawings reflecting the 'As-Shipped' state of the MCC documents previously submitted

2. Manufacturer drawings shall be provided in PDF format

3. Manufacturer drawings do not need to be stamped if a drawing schedule is provided that lists the drawing numbers, version levels, and status of drawings (such as, Preliminary, Approval, Final)

4. The contractor shall be responsible for making any changes to the 'As-Shipped' drawings from the manufacturer to reflect any field modifications

H. Manufacturer's Operation and Maintenance Manuals.

1. As-Shipped Drawings

2. Certificate of Quality Conformance

3. Maintenance data

4. MCC installation instructions

5. Installation/operation instructions for major components

6. MCC spare parts listing and pricing

1.7 QUALITY ASSURANCE

A. The manufacturer of the MCC shall have a minimum of 45-years of experience in the manufacturing and assembly of NEMA Low Voltage motor control centers.

B. The manufacturer shall have ISO 9001 registered facilities for the design, manufacture, and testing of MCCs.

C. MCC sections and individual MCC units shall be designed and manufactured in accordance with UL 845 requirements.

D. MCC sections and individual MCC units shall be UL listed, where possible.

1.8 REGULATORY REQUIREMENTS

A. Contractor shall ensure that the installation conforms to the requirements of the latest edition of the NFPA 70 'National Electrical Code' and/or other applicable installation standards.

1.9 DELIVERY, STORAGE, AND HANDLING

A. The contractor shall coordinate the shipping splits with the MCC manufacturer for entry into the building.

B. Shipping splits shall be noted on the MCC manufacturer drawings.

C. The contractor shall store the MCCs in a clean, dry, and heated space.

D. The contractor shall protect the units from dirt, water, construction debris, and traffic.

E. During storage the contractor shall connect internal space heaters (if recommended by manufacturer).

F. MCCs are to be shipped with external lifting angles at the top and running continuously for each shipping split. Lifting eyelets are not acceptable.

1.10 ENVIRONMENTAL REQUIREMENTS

A. The MCC enclosure rating shall be appropriate for the environment where the MCC is to be located as specified on the contract drawings.

1.11 FIELD MEASUREMENTS

A. The contractor shall verify all field measurements prior to the fabrication of the MCC.

1.12 WARRANTY

A. The manufacturer shall provide their standard parts warranty for 12 months from the date of shipment from the manufacturer's factory.

B. The manufacturer shall confirm this warranty as part of the submittal.

1.13 SPARE MATERIALS

A. The contractor shall review the manufacturer's recommended spare parts list and discuss it with the owner to determine requirements for spare parts.

B. The contractor is to provide the quotation for spare parts to the owner.

PART 2 MOTOR CONTROL CENTER SPECIFICATIONS

2.1 MANUFACTURERS

A. MCCs shall be Allen-Bradley® CENTERLINE® 2100 motor control centers or approved equal.

2.2 RATINGS

A. The MCC shall be rated for the system voltage as indicated on the contract drawings.

B. The MCC horizontal and vertical power bus bracing shall be rated to meet or exceed the available fault current as shown on the contract drawings, but shall not be less than 65,000 A rms symmetrical.

C. All MCC units shall have a full rated short-circuit rating that meets or exceeds the available fault current as shown on the contract drawings.

    1. The use of series short-circuit current ratings is not acceptable

D. All circuit breakers used in the motor control center shall have full-rated short-circuit current ratings based on the applied MCC voltage.

    1. Slash rated short-circuit interrupting ratings for circuit breakers are not acceptable.

2.3 ENCLOSURE

A. The MCC enclosure shall be NEMA Type 1 with gasket around perimeter of door.

B. Each section shall be equipped with two full-metal side sheets to isolate each vertical section and to help reduce the likelihood of fault propagation between sections.

C. All interior and exterior surfaces shall be painted ANSI 49 medium-light gray. The vertical wireways and unit back plates shall be painted high-visibility gloss white.

D. All unpainted parts shall be plated for corrosion resistance.

E. Removable closing plates on each end of the MCC shall cover all horizontal bus and horizontal wireway openings.

2.4 STRUCTURE

A. The MCC shall be of dead front construction and shall consist of one or more vertical sections bolted together to form a rigid, free-standing assembly. The systems shall be designed to allow for the addition of future sections at either end and to permit the interchanging of units.

B. Vertical sections shall be rigid, free-standing structures.

1. Vertical sections shall have internal mounting angles running continuously within the shipping block

2. An external mounting channel that is required to maintain structure integrity is not acceptable

3. Vertical sections shall be 90 in. high, 20 in. deep and 20 in. Wide, except where larger dimensions are required

4. Vertical sections shall be provided with a removable steel lifting angle on all shipping blocks. The angle shall run the length of the shipping block

5. Lifting eyes are not acceptable

6. Each standard section shall be capable of being subdivided into 12 usable, unit spaces

7. Two unit spaces shall constitute one space factor and shall be 13 in. in height

8. One unit space shall constitute one-half space factor and shall be 6.5 in. in height

C. Horizontal wireways.

1. Horizontal wireways shall be located at the top and bottom of the MCC

2. Horizontal wireways shall be 6 in. in height and extend the full depth of the vertical section to allow maximum flexibility in locating conduit for MCC feeds and loads

a. Pull-boxes to extend the height of the top horizontal wireway by 12 in. shall be provided, if specified on the contract drawings

3. Horizontal wireways shall be continuous across the length of the MCC, except where access needs to be denied due to electrical isolation requirements

4. The horizontal wireways shall be isolated from the power bus

5. The horizontal wireways shall have removable covers held in place by captive screws

D. Provide a full height vertical wireway, independent of the plug-in units, in each standard vertical section.

1. The vertical wireway shall be isolated from the vertical and horizontal buses
2. The vertical wireway shall be covered with a hinged and secured door
3. Wireway tie bars shall be provided
4. Isolation between the wireway and units shall be provided

2.5 BUS BARS

A. Horizontal Power Bus.

1. The horizontal bus shall be rated as shown on the drawings
2. The horizontal bus material shall be copper with tin plating
3. The horizontal bus shall be supported, braced and isolated from the vertical bus with a high strength, non-conductive, non-tracking, glass polyester material
4. For standard sections, the horizontal bus shall be continuous within each shipping block and shall be braced within each section
5. Horizontal bus splices shall have at least two bolts on each side

B. Vertical Bus.

1. The vertical power bus shall have an effective rating of 600 A. If a center horizontal bus construction is utilized, then the rating shall be 300 A above and below the horizontal bus for an effective rating of 600 A. If a top or bottom mounted horizontal bus is utilized, then the full bus must be rated for 600 A
2. The vertical bus material shall be copper with tin plating
3. The vertical bus shall attach to the horizontal bus with at least two bolts
4. The vertical bus shall be continuously braced by a high strength, non-conductive, non-tracking, glass-filled polyester material and isolated from the unit spaces by a non-conductive, polycarbonate molded cover
5. The vertical bus shall be isolated from the horizontal power bus except where necessary to connect the vertical power bus to the horizontal power bus
6. Automatic shutters shall cover plug-in stab openings when units are removed

C. Ground Bus.

1. Provide a ground bus system consisting of a horizontal ground bus connected to vertical ground buses mounted in each section
2. Provide an unplated copper 0.25 x 1 in horizontal ground bus mounted in the bottom of the MCC unless otherwise specified in the drawings

3. Provide a pressure-type mechanical lug mounted on the ground bus in the incoming line section

4. Provide a unit ground stab on all unit inserts. The ground stab shall establish unit insert grounding to the vertical ground bus before the plug-in power stabs engage the power bus. The grounding shall be maintained until after the plug-in power stabs are disengaged

D. Neutral Bus.

1. In a 4-wire system with a main incoming device rated more than 400 A, if there are no neutral loads in the MCC, an incoming neutral termination plate in the MCC main device unit that is connected to horizontal neutral bus in the section with the main is acceptable.

2. Neutral bus rating shall be same as the horizontal power bus rating

2.6 ETHERNET/IP COMMUNICATION

A. The MCC shall have Ethernet wiring incorporated into its design.

1. The MCC shall have factory installed industrial Ethernet cabling incorporated throughout the vertical section across the entire lineup

2. Each motor starter, electronic overload relay, power monitor, AC drive, and soft starter unit in the MCC shall be supplied with a means to communicate via EtherNet/IP network

3. Plug-in units should be able to move around without impacting the network

4. Maintenance activities should be able to be performed without impacting the network

B. Industrial Ethernet Switch.

1. The MCC shall have managed industrial Ethernet switch(s) with Ports to connect each EtherNet/IP enabled device

2. Ethernet Switches shall be provided with spare ports to accommodate network expansion and future plug-in unit inserts

3. The managed industrial Ethernet switch shall deliver optimal network security, network resiliency (if needed), and flexibility. The functionality should include port based control/prioritization, switch-level ring support, VLAN segmentation, and other Layer-2 switch features

4. The managed industrial Ethernet switch shall have the ability to include, if needed, Gigabit ports, CIP Sync functionality, Network Address Translation (NAT), and an Industrial SD Card

5. The managed industrial Ethernet switch shall include redundant terminal blocks for customer supplied/connection of an external 24V DC UPS

C. Industrial Ethernet Switch Layout.

1. Layout – Fixed-Mount Switch Unit

a. The managed industrial Ethernet Switch shall be mounted in a fixed-mount, Switch Unit in the top of the section

b. The industrial Ethernet cable shall connect each switch to one another in a linear topology

c. The Switch Unit shall be provided with a locking latch

d. The Switch Unit shall be provided with a door mounted viewing window

e. The Switch Unit shall be provided with a door mounted external network connector

D. Industrial Ethernet Cabling.

1. Industrial Ethernet Cable Ratings

a. The industrial Ethernet cable shall be 600V UL Category 5e PLTC rated

b. The use of a 300V rated cable is not acceptable

c. Ethernet Switch-to-Device cable labels shall be located on both ends of the cable to specify where the cable is connected to on both ends

d. A detailed Ethernet network table and Ethernet network diagram specifying IP addresses, subnet masks, device locations, cable label details, and 24V DC capacities shall be included in the MCC documentation

2. Layout – Homerun (direct switch-to-device) Ethernet Connections

a. An industrial Ethernet cable shall be routed from the managed industrial Ethernet Switch directly to the EtherNet/IP device in each unit

1) The industrial Ethernet cable shall be routed through the top or bottom horizontal wireway and transition through the vertical wireway directly to the EtherNet/IP device

2) The industrial Ethernet cable shall be secured to vertical wireway tie bars

b. The EtherNet/IP device within each unit shall be factory connected to the industrial Ethernet switch directly by using a 600V – UL rated Category 5e PLTC rated industrial Ethernet cable

3. Power Supplies.

    a. Power supplies shall provide 24V DC for the devices that require it

    b. The MCC manufacturer shall check the user's design to confirm that adequate power supplies have been specified to conform with network requirements

    c. Power supply output shall be rated 8 A, 24V DC

    d. Power supplies shall be Allen-Bradley Bulletin 1606-XLS240E or approved equal

    e. Power supply units shall be provided with a buffer module to provide a minimum of 500 ms ride-through at full load (the buffer module is optional for the standard Ethernet power supply)

    f. Buffer modules shall be Allen-Bradley Bulletin 1606-XLSBUFFER24 or approved equal

    g. Two (2) 24V DC adapters allowing four (4) power connections shall be provided:

        1) In each vertical wireway of standard sections to simplify installation, relocation and addition of plug-in units

        2) Each 24V DC adapter in the vertical wireway shall be connected to the power supply

    h. The power supplies units shall be provided with a door mounted external 120V AC connection for laptop power and Ethernet network connection

E. EtherNet/IP Interface for Motor Starter Units.

    1. Motor starter units shall have an electronic overload relay that incorporates the following features:

        a. Built-in EtherNet/IP communication

        b. Overload relay I/O powered by using 120V AC

        c. Status indicators for status indication

        d. Overload relays shall have a reset button on the outside of the unit door

        e. Selectable trip of NEMA Class 5 to 30. Unless indicated, the trip class shall be set for NEMA Class 20 operation

        f. Up to six (6) inputs and three (3) outputs of direct I/O. Additional I/O can be provided with an add-on module to the overload relay. Input voltage shall match the overload relay power voltage

g. Protective functions

1) Functions shall provide a programmable trip level, warning level, time delay, and inhibit window

2) Protective functions shall include Thermal overload, Phase loss, Stall, Jam, Underload, Current imbalance, Remote trip, and PTC thermistor input

3) Ground fault protection is required

(a) If ground fault protection is required, the protection range shall be

(b) 20 mA to 5 A

4) PTC Thermistor input is required

5) Voltage protection is required

(a) Input fusing shall not be used on NEMA 3 and smaller starters

h. Current monitoring functions shall include phase current, average current, full load current, current imbalance percent, percent thermal capacity utilized, and ground fault current (if required)

i. Voltage, energy, and frequency measuring capabilities shall be included when voltage protection is required

j. Diagnostic information shall include device status, warning status, time to reset, trip status, time to overload trip, and history of last five trips

k. Preventive maintenance information shall include Allowable starts per hour, required Time between starts, Starts counter, Starts available, Time until next start, total operating hours, and elapsed operating time

l. Overload relay shall include an on-board logic processor to allow basic logic to be performed within the overload relay based on network data and the status of the inputs to the overload relay

m. The overload relay shall support the following CIP messaging types: Polled I/O messaging, Change-of-state/cyclic messaging, Explicit messaging, Group 4 offline node recovery messaging, and Unconnected Message Manager (UCMM)

n. The overload relay shall provide the following functions to minimize network configuration time: Full parameter object support, Configuration consistency value, and Add-on Profile

o. The overload relay shall include a E300 Diagnostic Station connected to the overload relay by a single cable

2. The overload relay shall be Allen-Bradley 193-ECM ‘E300’ Electronic Overload or approved equal

F. EtherNet/IP Interface for Variable Frequency AC Drives and Solid-State Reduced Voltage Motor Controllers.

1. The EtherNet/IP communication interface shall be supplied to allow for communication between the solid-state component and the Ethernet network

G. EtherNet/IP Interface for Other Units.

1. Provide an EtherNet/IP interface for other units as indicated on the contract drawings

2. Refer to the contract drawing wiring diagrams for points to be monitored

H. Programming and Testing.

1. The MCC manufacturer shall load the IP Address and Subnet Mask into each unit and Ethernet switch

2. The IP Address shall be as indicated on the contract drawings or as provided by the contractor

3. The MCC manufacturer shall test the MCC to ensure that each unit communicates properly prior to shipment

4. The MCC manufacturer shall provide a disk containing applicable electronic data sheet (EDS) files for the EtherNet/IP devices

5. The IP Address shall not be visible on the unit Nameplate for any units containing an EtherNet/IP enabled device

6. All firmware will be provided with the same revision level of firmware across all similar intelligent electronic devices

a. E300 overload relays

b. PowerFlex 753, PowerFlex 755 drives

c. Stratix® 5700 switches

d. PowerMonitor™ 5000 energy meters

2.7 UNIT INFORMATION

A. The minimum compartment height shall be 6.5 in. and this shall be considered one-half space factor.

B. NEMA Size 5 FVNR starters and below shall be provided as plug-in units.

C. Plug-in units.

1. Plug-in units shall consist of a unit assembly, unit support pan, and unit door assembly

2. Units shall be supplied with removable doors. The unit doors shall be fastened to the structure so that the doors can be closed when the unit is removed

3. A unit support pan shall be provided for support and guiding units. Unit support pans shall remain in the structure when units are removed to provide isolation between units. A service position shall be provided for plug-in units that allows for the unit to be supported, but disengaged from the bus. The unit shall be capable of being padlocked in the service position. This position is to be used to isolate a unit from the bus to allow service to be performed on the connected load equipment

D. Power Stabs.

1. Unit stabs for engaging the power bus shall be tin-plated copper and provided with stainless back-up springs to provide and maintain a high-pressure, 4-point connection to the vertical bus

2. Wiring from the unit disconnecting means to the plug-in stabs shall not be exposed on the rear of the unit. A separate isolated pathway shall be provided for each phase to minimize the possibility of unit fault conditions reaching the power bus system

3. Power cable termination at the plug-in stab shall be a maintenance-free crimp type connection

E. Disconnect Handle.

1. Plug-in units shall be provided with a heavy-duty, non-conductive, industrial duty, flange mounted handle mechanism for control of each disconnect switch or circuit breaker

2. Use of rotary operators is not acceptable

3. Disconnect handles may pivot in the vertical or horizontal plane

4. On-off condition shall be indicated by the handle position, red and green color indicators with the words ON and OFF, and the international symbols 1 and O along with a pictorial indication of the handle position

5. Handles shall be capable of being locked in the OFF position with up to three padlocks

6. Plug-in units shall be provided with interlocks per NEMA and UL requirements Interlocks shall be provided for the following:

a. Prevention of unit insertion or withdrawal with the disconnect in the ON position

b. Prevention of the unit door from being opened when the disconnect is in the ON position

1) A feature for intentionally defeating this interlock by qualified personnel shall be provided

c. Prevention of the disconnect switch from being moved to the ON position if the unit door is open

1) A feature for intentionally defeating this interlock by qualified personnel shall be provided

F. Pilot Devices.

1. Where specified, units shall be furnished with pushbuttons, selector switches, elapsed time meteres, or pilot lights as shown on the contract drawings

2. Pilot devices shall be rated NEMA Type 4/13 water tight/oil tight

3. For units with vertically operated disconnect handles:

a. When three or less pilot devices are utilized, they shall be Allen-Bradley Bulletin 800H 30.5mm devices or approved equal

b. When more than three devices are required, the use of Allen-Bradley Bulletin 800F 22.5mm devices (or approved equal) is permitted

c. For Drives pilot devices:

1) 800F 22.5 mm devices or approved equal will be provided for all PowerFlex 750 and PowerFlex 520 series drives

4. For units with horizontally operated disconnect handles:

a. The devices shall be Allen-Bradley Bulletin 800F

G. Terminal Blocks.

1. Control terminal blocks shall be provided on all contactor and starter units.

a. Control terminal blocks shall be a pull-apart design on all plug-in units for easy removal of the unit from the structure

2. Control terminal blocks on non-plug-in contactor and starter units shall be fixed type

3. Power terminal blocks shall be provided on all contactor and starter units, rated NEMA size 3 (100 A) and below that utilize vertically operated disconnects

a. Power terminal blocks shall be pull-apart for NEMA size 1 and 2 (30 A and 60 A contactors)

b. Power terminal blocks for NEMA size 3 starters (100 A contactors) shall be non-pull-apart

4. Terminal blocks shall not be located adjacent to or inside the vertical wireway

H. Doors.

1. Each unit shall be provided with a removable door mounted on removable pin-type hinges

2. The unit doors shall be capable of being opened at least 110 degrees

3. The unit doors shall be removable from any location in the MCC without disturbing any other unit doors

4. The unit door shall be fastened to the structure so it can be closed to cover the unit space when the unit is removed

5. The unit doors shall be held closed with quarter-turn latches

2.8 METERING COMPARTMENT

A. MCCs shall include a plug-in metering unit.

B. Units shall include the following:

1. Fusible disconnect with fuses

a. The disconnect must be operable with the unit door closed

2. Fused control circuit transformer

3. Current transformers shipped loose to be installed by the contractor onto incoming power conductors

4. Solid-state power monitor with door mounted display

C. Power Monitor.

1. Power monitors shall be capable of displaying the following:

a. Line current for all three phases with plus or minus 0.2 percent full-scale accuracy

b. Average three phase current with plus or minus 0.2 percent full-scale accuracy

c. Line-to-neutral and line-to-line voltage with plus or minus 0.2 percent of full-scale accuracy

d. Current and voltage unbalance

e. Real, reactive, apparent, and true power with plus or minus 0.4 percent full-scale accuracy

f. KWh, KVARh, and kVAHnet

g. True RMS to the 45th harmonic

h. Frequency at plus or minus 0.5%

i. Power factor at plus or minus 0.4%

2. Power monitors shall include min/max logs and trend logs with up to 45,867 data points

3. Power monitors shall be capable of performing distortion analysis with THD, Crest Factor (I, V) and Distortion power factor

4. The power monitor shall include EtherNet/IP communication module

5. Power monitors shall include two form-C relays

6. Power monitors shall be Allen-Bradley PowerMonitor 5000 unit or approved equal

2.9 DISCONNECTS

A. Main Disconnect.

1. Main Circuit Breaker Disconnect (if specified in contract drawings)

a. Lugs to accommodate the incoming power conductors as indicated on the contract drawings shall be provided by the MCC manufacturer

b. Size the circuit breaker frame and trip rating as shown on the drawings

c. The interrupting capacity rating shall meet or exceed the available fault current as shown on the contract drawings

1) Interrupting capacity based on a slash rating is not acceptable

d. Provide a circuit breaker with thermal magnetic trip unit for under 225 A frames; provide electronic trip unit for 225 A and larger frames

e. Provide a removable protective barrier to reduce the possibility of incidental contact with the line terminals

f. Provide one normally open and one normally closed circuit breaker auxiliary contact that follows the position of the circuit breaker main contacts for indication of 'On' or 'Off/Tripped'

g. For circuit breakers rated 1000 A and above, on Wye connected systems with a solidly grounded neutral, provide integrated ground fault protection with adjustable pick-up and adjustable time delay

B. Feeder Disconnects

1. Disconnecting means for feeders shall be circuit breakers with thermal-magnetic trip units for under 225 A frames; provide an electronic trip unit for 225 A and larger frames

2. Interrupting capacity rating shall meet or exceed the available fault current as shown on the contract drawings

a. Interrupting capacity based on a slash rating is not acceptable

3. Minimum frame size shall be 125 A

4. Provide one normally open and one normally closed circuit breaker auxiliary contact which follows the position of the circuit breaker main contacts for indication of 'On' or 'Off/Tripped'

2.10 COMBINATION NEMA ACROSS THE LINE STARTERS

A. Starters shall meet applicable NEMA and UL requirements.

B. Starters shall be minimum NEMA Size 1.

1. Fractional NEMA sizes are not acceptable

C. The motor starter shall be Allen-Bradley Bulletin 500 or 300 or approved equal.

D. Starters shall be provided with a 3-pole solid state overload relay that includes the following features:

1. If EtherNet/IP communication is required, refer to the part of this section titled 'EtherNet/IP Interface for Motor Starter Units', which takes precedence over this overload relay requirement

2. Selectable trip classes of 5, 10, 15, 20, or 30 for E300 overloads

3. Set for class 20 unless otherwise indicated on the contract drawings

4. Overload protection

5. Phase loss protection

6. Trip current adjustment range of 5:1

7. Visual trip status indication

8. Test/Reset button

9. Bipolar latching relay with one normally open and one normally closed contact, rated NEMA B600 for use in motor contactor control circuits

10. Thermal memory circuit to model the heating and cooling effects of motor on and off periods

11. Ground Fault protection shall be provided

12. If ground fault protection is required, it shall have a selectable trip value between 20 mA and 5 A

13. The overload relay shall be Allen-Bradley E300 Electronic Overload

E. In addition to the hold-in contact, starters shall be provided with auxiliary contacts shown on the contract drawing wiring diagrams. The starter shall be capable of accommodating up to six contact in addition to the hold-in contact.

F. Provide a control power transformer with a rated secondary voltage of 120V AC. The control power transformer shall be provided with primary and secondary fusing.

G. Overload relays shall have a reset button located on the outside of the unit door.

H. Provide a door mounted selector switch for Hand-Off-Auto operation. The Hand mode shall provide local control at the MCC unit door. In the Auto mode, control shall be provided through a remote contact.

I. Provide door mounted E300 Diagnostic Station with LED lamps for On Red and Off Green status indication. Provide additional LED PTT pilots as shown on drawings.

2.11 MOTOR STARTER UNITS.

A. Electro-mechanical NEMA starters:

1. Disconnecting means for the across the line starters shall be motor circuit protectors

2. Unit short-circuit current rating shall be greater than or equal to the available fault current as shown on the contract drawings

3. Units shall be supplied based upon the rules/requirements set forth in the UL 845, NEMA ICS-18, and NFPA 70

4. Contractor shall field adjust the units based upon the particular motor application.

5. Minimum MCP frame size shall be 125 A

6. Provide one normally open and one normally closed circuit breaker auxiliary contact that follows the position of the circuit breaker main contacts for indication of 'On' or 'Off/Tripped'

2.12 VARIABLE FREQUENCY DRIVES

A. Variable frequency drives shall be Allen-Bradley PowerFlex 753 drives.

1. Refer to section 26 29 23 for specifications

B. Provide a control power transformer with a rated secondary voltage of 120V AC. The control power transformer shall be provided with primary and secondary fusing.

C. Provide door-mounted pilot devices per the contract drawing wiring diagrams.

D. Provide door-mounted 120V AC push-to-test pilot lights with LED lamps as shown on contract drawings.

E. Provide a door-mounted human interface module for programming, display and control.

F. Provide one isolated, configurable analog input and output.

G. MCC-mounted Active Harmonic Filters (AHF), as specified below, shall be furnished for harmonic mitigation of the MCC-connected loads

1. Limit harmonic current to <5% Total Demand Distortion (TDD) per IEEE519-1992, table 10.3

2. AHFs shall be capable of parallel connection of multiple units to meet the required level of mitigation

3. Door-interlocked disconnect shall be furnished

4. Shall include electronic output current limiting and over-temperature protection

5. Current Transformers (CTs) shall be supplied for field installation on the MCC incoming power cabling

6. Operator interface shall be via LCD touchscreen for ON, OFF, parameter configuration and display of power quality, operational status and parameter settings

7. Relay contacts shall be provided for ON, Fault and Load Status

8. Communication capabilities shall include RS232 and Ethernet/IP

9. Rating shall be Heavy duty

10. Design is based on TCI Active Harmonic Filter

2.13 SOFTWARE

A. Preconfigured Software.

1. Software shall be capable of viewing multiple MCC lineups
2. Software communication driver shall allow the software to be installed and operated on the EtherNet/IP or DeviceNet network
3. Software shall be capable of functioning as a standalone software package or as an ActiveX control in a Human Machine Interface (HMI)
4. Software shall be capable of displaying the following

a. Elevation View

1) Dynamically displays status information based on reading data from devices in the MCC lineup
2) Sizeable graphical/virtual representation to allow ease of viewing multiple MCC lineups
3) Unit nameplate information
4) Unit status indicators (ready, running, warning, fault, no communication)
5) Should be able to add devices, move devices, add sections and move sections

b. Unit Monitor View

1) Preconfigured for a specific unit
2) Real-time monitoring via real-time analog dials, parameter value display, and data trending
3) Data configurable for customized viewing
4) Modifying device parameters
5) Data trend export functionality to .csv file

c. Spreadsheet View

1) User configurable for customized monitoring displaying maximum information about the lineup
2) Sorting and cascading functions
3) Custom user fields

d. Event Log

1) Track history of MCC unit

2) Automatic logging of trips, warnings, and changes

3) Manual entry of events

e. Documentation

1) Front elevation drawings

2) Unit wiring diagrams

3) User manuals

4) Spare parts lists

5) Ability to add and/or update documentation

f. Integration Assistant

1) Integrate the MCCs into the PLC software and generate required tags and IP address configurations for devices:

(a) Choose from device_IP address or Nameplate_IP address for tag naming convention

(b) Ability to map devices to any EtherNet/IP communication cards in the PLC I/O chassis

(c) IP addressing, motor and control data shall be programmed at the factory (information provided prior to manufacture)

PART 3 EXECUTION

3.1 INSTALLATION

A. Contractor shall install MCC in accordance with manufacturer's instructions.

B. Contractor shall tighten accessible bus connections and mechanical fasteners to the manufacturer's torque requirements.

C. Contractor shall select and install fuses in fusible switches based upon field requirements.

D. Contractor shall adjust circuit breaker settings based upon field requirements and/or Arc Flash Study results.

E. Contractor shall adjust solid state overloads to match the installed motor characteristics.

3.2 MANUFACTURER'S SERVICES

A. Manufacturer of the MCC shall be capable of providing the programming for the programmable logic controller and the operator interface if provided within the MCC.

B. Manufacturer of the MCC shall be capable of providing start-up services as part of the supply of the MCC.

C. Startup Services shall consist of a minimum of 5 days per MCC

3.3 TRAINING

A. A course outline shall be submitted as part of the MCC submittals.

B. The manufacturer shall offer on-site training on the concepts, knowledge and tools necessary to troubleshoot, and use a networked MCC.

C. Training shall consist of two 4 hour periods

END OF SECTION

SECTION 26 2717 - EQUIPMENT WIRING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electrical connections to equipment.

1.2 RELATED REQUIREMENTS

A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.

B. Section 26 0534 - Conduit.

C. Section 26 0537 - Boxes.

D. Section 26 2726 - Wiring Devices.

E. Section 26 2818 - Enclosed Switches.

F. Section 26 2913 - Enclosed Controllers.

1.3 REFERENCE STANDARDS

A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (R 2010).

B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2012.

C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.

2. Determine connection locations and requirements.

B. Sequencing:

1. Install rough-in of electrical connections before installation of equipment is required.

2. Make electrical connections before required start-up of equipment.

1.5 SUBMITTALS

A. Product Data: Provide wiring device manufacturer’s catalog information showing dimensions, configurations, and construction.

B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Products: Listed, classified, and labeled as suitable for the purpose intended.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.

1. Colors: Comply with NEMA WD 1.

2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.

3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

B. Disconnect Switches: As specified in Section 26 2818 and in individual equipment sections.

C. Wiring Devices: As specified in Section 26 2726.

D. Liquid-tight Flexible Metal Conduit: As specified in Section 26 0534.

E. Wire and Cable: As specified in Section 26 0519.

F. Boxes: As specified in Section 26 0537.

2.2 EQUIPMENT CONNECTIONS

A. Provide as indicated on the Contract Drawings:

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 ELECTRICAL CONNECTIONS

A. Make electrical connections in accordance with equipment manufacturer's instructions.

B. Make conduit connections to equipment using liquid-tight flexible metal conduit with watertight connectors.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. Provide receptacle outlet to accommodate connection with attachment plug.

E. Provide cord and cap where field-supplied attachment plug is required.

F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.

H. Install terminal block jumpers to complete equipment wiring requirements.

I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION

SECTION 26 2726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wall switches.

B. Receptacles.

C. Wall plates and covers.

1.2 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0537 - Boxes.

C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 26 0922 - Lighting Control Devices.

E. Section 26 2717 - Equipment Wiring: Cords and plugs for equipment.

1.3 REFERENCE STANDARDS

A. FS W-C-596 - Connector, Electrical, Power, General Specification for; Federal Specification; Revision G, 2001.

B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification); Federal Specification; Revision F, 1999.

C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.

E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (R 2010).

F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2012.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.

I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.

J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.

K. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.

2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.

3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.

4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.

5. Notify Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

B. Sequencing:

1. Do not install wiring devices until final surface finishes and painting are complete.

1.5 SUBMITTALS

A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

B. Field Quality Control Test Reports.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. Operation and Maintenance Data:

1. GFCI Receptacles: Include information on status indicators.

E. Project Record Documents: Record actual installed locations of wiring devices.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Keys for Locking Switches: Two of each type.

2. Extra Wall Plates: Two of each style, size, and finish.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Products: Listed, classified, and labeled as suitable for the purpose intended.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Lutron Electronics Company, Inc: www.lutron.com.

B. Legrand

2.2 WIRING DEVICE APPLICATIONS

A. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors, in damp or wet locations, or where indicated on the contract drawings.

B. Provide GFCI protection for receptacles installed within 6 feet of sinks, toilets, showers, hoses, etc..., or where indicated on the contract drawings.

C. Provide GFCI protection for receptacles installed in kitchens, bathrooms, labs, etc...

2.3 WIRING DEVICE FINISHES

A. Provide wiring device finishes as noted on E-001, Legend.

2.4 WALL SWITCHES

A. Manufacturers:

1. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.

B. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.

1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.

2. Coordinate device and faceplate cover colors with the Engineer and Owner.

C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

D. Pilot Light Wall Switches: Industrial specification grade, 20 A, 120/277 V with red illuminated standard toggle type switch actuator and maintained contacts; illuminated with load on; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

E. Keyed Wall Switches: Industrial specification grade, 20 A, 120/277 V with lever type keyed switch actuator and maintained contacts; all switches keyed alike; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

2.5 RECEPTACLES

A. Manufacturers:

1. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.

2. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.

B. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.

1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.

2. NEMA configurations specified are according to NEMA WD 6.

C. Convenience Receptacles:

1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.

2. Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.

D. GFCI Receptacles:

1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.

a. Provide test and reset buttons of same color as device.

2. Standard GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.

3. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.

2.6 WALL PLATES AND COVERS

A. Manufacturers:

1. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.

2. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.

B. Wall Plates: Comply with UL 514D.

1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.

2. Finish: Refer to E-001, Legend.

C. Weatherproof Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.

C. Verify that wall openings are neatly cut and will be completely covered by wall plates.

D. Verify that final surface finishes are complete, including painting.

E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

F. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.

B. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of wiring devices provided under this section.

1. Mounting Heights: Unless otherwise indicated, as follows:

a. Wall Switches: 48 inches above finished floor.

b. Receptacles: 18 inches above finished floor, 6 inches above counter, or as indicated on the Contract Drawings.

2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.

3. Where multiple receptacles or wall switches are installed at the same location and at the same mounting height, gang devices together under a common wall plate.

4. Locate wall switches on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Engineer to obtain direction prior to proceeding with work.

C. Install wiring devices in accordance with manufacturer's instructions.

D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.

F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.

G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.

H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.

I. Install wiring devices plumb and level with mounting yoke held rigidly in place.

J. Install wall switches with OFF position down.

K. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.

L. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.

M. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

N. Identify wiring devices in accordance with Section 26 0553.

3.4 FIELD QUALITY CONTROL

A. Inspect each wiring device for damage and defects.

B. Operate each wall switch with circuit energized to verify proper operation.

C. Test each receptacle to verify operation and proper polarity.

D. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.

E. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.5 ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.6 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

SECTION 26 2727 - EQUIPMENT FOR HAZARDOUS LOCATIONS

PART 1 GENERAL

1.1 RELATED WORK

A. Basic Materials and Methods

1.2 QUALITY CONTROL

A. Product Quality Control:

1. Manufacturers shall fabricate their products in such a manner that all criteria for appearance, fit and tolerances shall be complied with.

2. Each manufacturer shall carefully control his operations to ensure that the engineering, quality, safety and reliability of product are achieved.

1.3 SUBMITTALS

A. Product Data: Submittals are required for the products contained within this Section, including:

1. List of materials to be used.

2. Catalog cuts of all materials and equipment.

PART 2 PRODUCTS

2.1 MATERIALS

A. Basic Electrical Materials: Those Products such as conduit, wire, connectors, cable, support devices, fasteners, and similar devices, as required for Work of this Section are specified elsewhere.

2.2 GENERAL REQUIREMENTS

A. Provide equipment, fittings and wiring indicated for installation within the spaces referenced on the Drawings, which are approved by the NEC for Class 1, Division 1 and 2, Group D as specifically designed for this type of hazardous use.

B. Engage at least five full threads on conduit connections to couplings and fitting hubs. Coat threads with sealing compound to make connections gas tight. Sealing fittings shall be properly installed at all required locations in accordance with code regulations.

C. All wiring methods to be in compliance with NEC article 500.

2.3 CONDUIT SEAL-OFF FITTINGS

A. Provide conduit seal-off fittings on conduit runs entering or leaving the areas referenced on the Drawings as being hazardous.

B. Fittings shall conform to the classification as defined by the NEC Article 500 as being Class 1, Division 1 and 2, Group D.

C. Acceptable Manufacturers:

1. Crouse Hinds Type EYS.

2. Russell Stoll.

3. Appleton Electric Company.

4. Approved equal.

2.4 CONDUIT UNIONS

A. Conduit unions shall conform to Types UNF/UNY as manufactured by the Crouse Hinds Company or equal. Contractor to install a union fitting within 6" of each required seal-off fitting. All requirements to be per NEC.

2.5 FLEXIBLE COUPLINGS

A. Flexible couplings shall conform to Types ECLK/ECGJH as manufactured by the Crouse Hinds Company or equal. Actual length of coupling shall be determined by job conditions.

2.6 EXPANSION JOINTS

A. Expansion joints shall conform to Types UNF/UNY as manufactured by the Crouse Hinds Company or equal.

2.7 JUNCTION BOXES

A. Junction boxes for suspended type conduit runs shall conform to Type GUA as manufactured by the Crouse Hinds Company or equal. Junction boxes for surface mounted conduit runs shall conform to Type GUJ as manufactured by the Crouse Hinds Company or approved equal.

2.8 PULL BOXES

A. Pull boxes shall conform to Type EXB as manufactured by the Appleton Electric company or equal. Body of each pull box shall be provided with the proper size and

number of drilled and tapped conduit openings. Size of each pull box shall be as per installation and NEC requirements.

2.9 SWITCHES, RECEPTACLES AND FITTINGS

A. Such devices shall comply with the appropriate section. In addition, install said devices in the proper type of surface mounted enclosure.

1. Local control lighting switch: Refer to appropriate section.

2. Standard type receptacles: Provide receptacles rated 20 amps, 125 volt, 2 poles, 3 wires, and of the heavy duty delayed action, circuit breaking, and grounding type. Provide surface mounted, angle configuration design receptacles having a cover flap with the enclosure. Provide a matching male plug with each outlet.

B. Acceptable Manufacturers:

1. Crouse Hinds.

2. Russell Stoll.

3. Appleton Electric Company.

4. Or approved equal.

2.10 CORD CONNECTORS

A. Cord connectors shall be sized accordingly and shall be suitable for passing a cord into a rigid conduit from a Class 1, Division 1 and 2, Group D Hazardous environment. All cord connectors shall have a wire mesh strain relief mechanism.

PART 3 EXECUTION

3.1 INSPECTION

A. Carefully investigate the structural and finish condition, as well as other construction work which may affect the work of this Section. Arrange Electrical Work accordingly and furnish such fittings and apparatus as required to accommodate such conditions and to preserve access to other equipment, rooms, areas, etc.

B. Prior to performance of work described above, make detailed drawings of proposed departures from original design due to field conditions or other cause, and submit for Engineer's approval.

C. Inspect installed conduit and remove obstructions. Conduits shall be blown out and mandreled to remove dirt and debris as applicable.

3.2 PREPARATION

A. Field Measurement: The Contract Drawings are generally indicative of the Work, but due to their small scale, it is not possible to indicate all offsets, fittings, and apparatus required nor the minor structural obstructions that may be encountered.

B. Obtain roughing-in dimensions of electrically operated equipment being installed in other construction work. Set conduit and boxes only after receiving approved dimensions and checking such equipment locations.

C. Layout electrical work to suit actual field measurements and according to accepted Trade standard practice. However, electrical installations shall conform to NEC 500 for wiring methods general requirements, and to all other applicable Articles of the NEC governing methods of wiring.

3.3 INSTALLATION

A. Methods of Wiring: In general, fabricate conduit systems in accordance with accepted Trade standard practice. The following installation requirements are in addition to requirements set forth in Articles 501 of the NEC, and are included to complement same.

1. Cut conduits and raceways square and debur cuts to the same degree as cuts made by the material manufacturer. Ream cuts of conduits per NEC requirements with openings not restricted more than cuts made by the material manufacturer.

2. Consult conduit specification for additional information on requirements for conduit installation throughout the area.

3. Wiring in Hazardous Locations as indicated on the Drawings shall conform to Article 501, Class 1, Division 1 and 2, Group D, Hazardous Locations, of the National Electrical Code, as applicable, and to the following:

    a. Use RMC conduit with threaded explosion proof joints, and explosion proof boxes and fittings at these locations. Make up threaded joints with at least five full threads engaged.

    b. Seal conduit entering or leaving the hazardous areas with approved sealing fittings at the point where they enter or leave the hazardous area.

    c. Splices and taps shall not be made in sealing condulets; (they are not acceptable design for such purpose); neither shall splices or taps in other condulets be covered by compound.

    d. In order to remove the accumulation of water from the conduit system, grade the conduit away from the sealing fittings. Provide drain fittings at the lowest point in the system.

B. Wiring: Install wiring in conduit (PVC Coated RGS), unless indicated otherwise on the Drawings and as specified.

3.4 ANCHOR AND FASTENER INSTALLATIONS

A. Auxiliary Support Structure Fabrication: Insofar as possible, fit and shop assemble fabrications and make ready for field installation.

1. Drill or punch holes as required for attachment of work and for bolted connections. Burned holes are not acceptable.

2. Dress welds smooth and free of sharp edges and corners.

B. Threaded Bolts: Draw threaded bolted connections uptight using 316 stainless steel lock washers to prevent bolt or nut loosening.

C. Drilled-In epoxy or adhesive Anchor Installation: As specified.

END OF SECTION

SECTION 26 2813 - FUSES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Fuses.

1.2 RELATED REQUIREMENTS

A. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

B. Section 26 0573 - Power System Studies: Additional criteria for the selection of protective devices specified in this section.

C. Section 26 2818 - Enclosed Switches: Fusible switches.

D. Section 26 2913 - Enclosed Controllers: Fusible switches.

1.3 REFERENCE STANDARDS

A. NEMA FU 1 - Low Voltage Cartridge Fuses; 2012.

B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements; Current Edition, Including All Revisions.

D. UL 248-4 - Low-Voltage Fuses - Part 4: Class CC Fuses; Current Edition, Including All Revisions.

E. UL 248-10 - Low-Voltage Fuses - Part 10: Class L Fuses; Current Edition, Including All Revisions.

F. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.

a. Fusible Enclosed Switches: See Section 26 2818.

b. Fusible Switches for Enclosed Motor Controllers: See Section 26 2913.

2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.

3. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.

B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Fuses: Two set(s) of three for each type and size installed.

2. Fuse Pullers: One set(s) compatible with each type and size installed.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Bussmann, a division of Eaton Corporation: www.cooperindustries.com.

B. Littelfuse, Inc: www.littelfuse.com.

2.2 APPLICATIONS

A. Service Entrance:

1. Fusible Switches up to 600 Amperes: Class RK5, time-delay.

2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.

B. Feeders:

1. Fusible Switches up to 600 Amperes: Class RK5, time-delay.
2. Fusible Switches Larger Than 600 Amperes: Class L, time-delay.

C. General Purpose Branch Circuits: Class RK1, time-delay.

D. Individual Motor Branch Circuits: Class RK1, time-delay.

E. In-Line Protection for Pole-Mounted Luminaires: Class CC, time-delay.

F. Primary Protection for Control Transformers: Class CC, time-delay.

2.3 FUSES

A. Provide products listed, classified, and labeled as suitable for the purpose intended.

B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.

C. Provide fuses of the same type, rating, and manufacturer within the same switch.

D. Comply with UL 248-1.

E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.

F. Voltage Rating: Suitable for circuit voltage.

G. Class R Fuses: Comply with UL 248-12.

H. Class L Fuses: Comply with UL 248-10.

I. Class CC Fuses: Comply with UL 248-4.

J. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.

B. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Do not install fuses until circuits are ready to be energized.

B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION

SECTION 26 2818 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Enclosed safety switches.

1.2 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 26 0573 - Power System Studies: Additional criteria for the selection of equipment and associated protective devices specified in this section.

E. Section 26 2813 - Fuses.

F. Section 26 2913 - Enclosed Controllers: Manual motor controllers.

G. Section 26 3600 - Transfer Switches: Automatic and non-automatic switches listed for use as transfer switch equipment.

1.3 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.

H. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

I. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.

4. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.

B. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

C. Field Quality Control Test Reports.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

E. Project Record Documents: Record actual locations of enclosed switches.

F. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

A. Maintain ambient temperature between -22 degrees F and 104 degrees F during and after installation of enclosed switches.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Eaton Corporation: www.eaton.com.

B. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

1. To clarify, all power distribution equipment (panelboards, transformers, safety switches, controllers, etc.) as part of this Contract shall be produced by a single manufacturer and supplied by a single supplier.

2.2 ENCLOSED SAFETY SWITCHES

A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:

1. Altitude: Less than 6,600 feet.

2. Ambient Temperature: Between -22 degrees F and 104 degrees F.

D. Horsepower Rating: Suitable for connected load.

E. Voltage Rating: Suitable for circuit voltage.

F. Short Circuit Current Rating:

    1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

    2. Minimum Ratings:

        a. Switches Protected by Class H Fuses: 100,000 rms symmetrical amperes.

        b. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses: 200,000 rms symmetrical amperes.

G. Enclosed Safety Switches Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.

H. Provide with switch blade contact position that is visible when the cover is open.

I. Fuse Clips for Fusible Switches: As required to accept fuses indicated.

    1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.

J. Conductor Terminations: Suitable for use with the conductors to be installed.

K. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

L. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.

M. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.

    1. Environment Type per NEMA 250: As indicated on the drawings.

    2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.

N. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

O. Heavy Duty Switches:

    1. Comply with NEMA KS 1.

2. Conductor Terminations:

    a. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.

    a. Provide means for locking handle in the ON position where indicated.

4. General duty switches are not acceptable.

P. Provide the following features and accessories where indicated or where required to complete installation:

1. Auxiliary Switch: SPDT switch suitable for connection to system indicated, with auxiliary contact operation before switch blades open and after switch blades close. Refer to the Contract Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed safety switches.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment in accordance with Section 26 0529.

E. Install enclosed switches plumb.

F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.

G. Provide grounding and bonding in accordance with Section 26 0526.

H. Provide fuses complying with Section 26 2813 for fusible switches as indicated or as required by equipment manufacturer's recommendations.

I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

J. Identify enclosed switches in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.

C. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.4 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 2913 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Enclosed NEMA controllers for low-voltage (600 V and less) applications:

1. Magnetic motor starters.
2. General purpose contactors.
3. Manual motor starters.
4. Motor-starting switches.

B. Overcurrent protective devices for motor controllers, including overload relays.

C. Control accessories:

1. Auxiliary contacts.
2. Pilot devices.
3. Control and timing relays.
4. Control power transformers.
5. Control terminal blocks.

1.2 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 26 0573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

E. Section 26 2419 - Motor-Control Centers.

F. Section 26 2813 - Fuses: Fuses for fusible switches.

G. Section 26 2923 - Variable-Frequency Motor Controllers.

1.3 REFERENCE STANDARDS

A. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers; 2008.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

D. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000 (R2005), with errata, 2008.

E. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices; 2000 (R2010).

F. NEMA ICS 6 - Industrial Control and Systems: Enclosures; 1993 (R2011).

G. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.

H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

J. UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules; Current Edition, Including All Revisions.

K. UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contractors and Motor-starters - Electromechanical Contractors and Motor-starters; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.

2. Coordinate the work to provide motor controllers and associated overload relays suitable for use with the actual motors to be installed.

3. Coordinate the work to provide controllers and associated wiring suitable for interface with control devices to be installed.

4. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

5. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.

6. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor controllers, enclosures, overcurrent protective devices, and other installed components and accessories.

1. Include characteristic trip curves for each type and rating of overcurrent protective device.

B. Shop Drawings: Indicate dimensions, voltage, controller sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

1. Include dimensioned plan and elevation views of enclosed controllers and adjacent equipment with all required clearances indicated.

2. Include wiring diagrams showing all factory and field connections.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. Field Quality Control Test Reports.

E. Project Record Documents: Record actual installed locations of controllers and final equipment settings.

1. Include nameplate data of actual installed motors and associated overload relay selections and settings.

2. Motor Circuit Protectors: Include magnetic instantaneous trip settings.

F. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Indicating Lights: Two of each different type.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

A. Maintain field conditions within required service conditions during and after installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Eaton Corporation; Cutler-Hammer Products. : www.eaton.com.

B. Source Limitations: Furnish enclosed motor controllers and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

1. To clarify, all power distribution equipment (panelboards, transformers, safety switches, controllers, etc.) as part of this Contract shall be produced by a single manufacturer and supplied by a single supplier.

2.2 ENCLOSED CONTROLLERS

A. Provide enclosed controller assemblies consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Description: Enclosed controllers complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; ratings, configurations and features as indicated on the drawings.

D. Service Conditions:

1. Provide controllers and associated components suitable for operation under the following service conditions without derating:

a. Altitude:

1) Class 1 Km Equipment (devices utilizing power semiconductors, e.g. variable frequency controllers): Less than 3,300 feet.

2) Class 2 Km Equipment (electromagnetic and manual devices): Less than 6,600 feet.

b. Ambient Temperature: Between 32 degrees F and 104 degrees F.

2. Provide controllers and associated components suitable for operation at indicated ratings under the service conditions at the installed location.

E. Short Circuit Current Rating:

1. Provide controllers with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.

F. Conductor Terminations: Suitable for use with the conductors to be installed.

G. Enclosures:

1. Comply with NEMA ICS 6.

2. Environment Type per NEMA 250: As indicated on the drawings.

3. Finish: Manufacturer's standard unless otherwise indicated.

H. Instrument Transformers:

1. Comply with IEEE C57.13.

2. Select suitable ratio, burden, and accuracy as required for connected devices.

3. Current Transformers: Connect secondaries to shorting terminal blocks.

4. Potential Transformers: Include primary and secondary fuses with disconnecting means.

I. Magnetic Motor Starters: Combination type unless otherwise indicated.

1. Combination Magnetic Motor Starters: NEMA ICS 2, Class A combination motor controllers with magnetic contactor(s), externally operable disconnect and overload relay(s).

2. Noncombination Magnetic Motor Starters: NEMA ICS 2, Class A noncombination motor controllers with magnetic contactor(s) and overload relay(s).

3. Configuration: Full-voltage non-reversing unless otherwise inidcated on the Contract Drawings.

4. Minimum Starter Size: NEMA Size 0.

5. Use of non-standard starter sizes smaller than specified standard NEMA sizes is not permitted.

6. Disconnects: Circuit breaker type.

    a. Circuit Breakers: Motor circuit protectors (magnetic-only) unless otherwise indicated or required.

    b. Provide externally operable handle with means for locking in the OFF position. Provide safety interlock to prevent opening the cover with the disconnect in the ON position with capability of overriding interlock for testing purposes.

    c. Provide auxiliary interlock for disconnection of external control power sources where applicable.

7. Overload Relays: Bimetallic thermal type unless otherwise indicated.

8. Pilot Devices Required:

    a. Furnish local pilot devices for each unit as specified below unless otherwise indicated on drawings.

    b. Single-Speed, Non-Reversing Starters:

        1) Pushbuttons: START-STOP.

        2) Selector Switches: HAND/OFF/AUTO.

        3) Indicating Lights: Red ON, Green OFF.

    c. Single-Speed, Reversing Starters:

        1) Pushbuttons: FOR-REV-STOP.

        2) Selector Switches: FOR/OFF/REV.

        3) Indicating Lights: Red FOR, Red REV, Green OFF.

d. Two-Speed Starters:

1) Pushbuttons: FAST-OFF-SLOW.

2) Selector Switches: SLOW/OFF/FAST.

3) Indicating Lights: Red FAST, Red SLOW, Green OFF.

J. General Purpose Contactors: Combination type unless otherwise indicated.

1. Combination Contactors: NEMA ICS 2, Class A combination controllers with magnetic contactor(s) and externally operable disconnect, but without integral overload relay(s).

2. Noncombination Contactors: NEMA ICS 2, Class A noncombination motor controllers with magnetic contactor(s), but without integral overload relay(s).

3. Configuration: Full-voltage non-reversing unless otherwise indicated.

4. Minimum Contactor Size: NEMA Size 0.

5. Use of non-standard contactor sizes smaller than specified standard NEMA sizes is not permitted.

6. Disconnects: Circuit breaker type.

a. Circuit Breakers: Thermal magnetic unless otherwise indicated or required.

b. Provide externally operable handle with means for locking in the OFF position. Provide safety interlock to prevent opening the cover with the disconnect in the ON position with capability of overriding interlock for testing purposes.

c. Provide auxiliary interlock for disconnection of external control power sources where applicable.

K. Manual Motor Starters:

1. Description: NEMA ICS 2, Class A manually-operated motor controllers with overload relay(s).

2. Configuration: Non-reversing unless otherwise indicated.

3. Fractional-Horsepower Manual Motor Starters:

a. Furnish with toggle operator.

b. Overload Relays: Bimetallic or melting alloy thermal type.

c. Provide means for locking operator in the OFF or ON position.

d. Furnish Red ON indicating light.

4. Integral-Horsepower Manual Motor Starters:

a. Furnish with toggle or pushbutton operator.

b. Overload Relays: Bimetallic or melting alloy thermal type.

c. Provide means for locking operator in the OFF or ON position.

d. Furnish Red ON indicating light.

e. Provide auxiliary contact; normally open (NO) or normally closed (NC) as indicated or as required.

L. Motor-Starting Switches: Horsepower-rated switches without overload protection; toggle operator.

2.3 OVERCURRENT PROTECTIVE DEVICES

A. Overload Relays:

1. Provide overload relays and, where applicable, associated current elements/heaters, selected according to actual installed motor nameplate data, in accordance with manufacturer's recommendations and NFPA 70; include consideration for motor service factor and ambient temperature correction, where applicable.

2. Inverse-Time Trip Class Rating: Class 20 unless otherwise indicated or required.

3. Trip-free operation.

4. Visible trip indication.

5. Resettable.

a. Employ manual reset unless otherwise indicated.

b. Do not employ automatic reset with two-wire control.

6. Bimetallic Thermal Overload Relays:

a. Interchangeable current elements/heaters.

b. Adjustable trip; plus/minus 10 percent of nominal, minimum.

c. Trip test function.

7. Melting Alloy Thermal Overload Relays:

a. Interchangeable current elements/heaters.

B. Circuit Breakers:

1. Interrupting Capacity (not applicable to motor circuit protectors):

a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.

b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.

2. Motor Circuit Protectors:

a. Description: Instantaneous-trip circuit breakers furnished with magnetic instantaneous tripping elements for short circuit protection, but not with thermal inverse time tripping elements for overload protection; UL 489 recognized only for use as part of a listed combination motor controller with overload protection; ratings, configurations, and features as indicated on the drawings.

b. Provide field-adjustable magnetic instantaneous trip setting.

c. Provide the following features and accessories where indicated or where required to complete installation:

1) Pad-Lock Provision: For locking circuit breaker handle in OFF position.

2) Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.

3. Molded Case Circuit Breakers:

a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers; listed and labeled as complying with UL 489; ratings, configurations, and features as indicated on the drawings.

1) Provide thermal magnetic circuit breakers unless otherwise indicated.

2) Provide electronic trip circuit breakers where indicated.

b. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.

1) Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 100 amperes and larger.

2) Provide interchangeable trip units where indicated.

c. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.

1) Provide the following field-adjustable trip response settings:

(a) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.

(b) Long time delay.

(c) Short time pickup and delay.

(d) Instantaneous pickup.

d. Provide the following features and accessories where indicated or where required to complete installation:

1) Pad-Lock Provision: For locking circuit breaker handle in OFF or ON position as indicated.

2) Auxiliary Switch: SPDT switch suitable for connection to system indicated for indicating when circuit breaker has tripped or been turned off.

2.4 CONTROL ACCESSORIES

A. Auxiliary Contacts:

1. Comply with NEMA ICS 5.

2. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking, plus one normally open (NO) and one normally closed (NC) spare contact for each magnetic motor starter, minimum.

B. Pilot Devices:

1. Comply with NEMA ICS 5; heavy-duty type.

2. Nominal Size: 30 mm.

3. Pushbuttons: Unless otherwise indicated, provide momentary, non-illuminated type with flush button operator; normally open or normally closed as indicated or as required.

4. Selector Switches: Unless otherwise indicated, provide maintained, non-illuminated type with knob operator; number of switch positions as indicated or as required.

5. Indicating Lights: Push-to-test type unless otherwise indicated.

6. Provide LED lamp source for indicating lights and illuminated devices.

C. Control and Timing Relays:

1. Comply with NEMA ICS 5.

2. Provide number and type of relays indicated or required to perform necessary functions.

D. Control Power Transformers:

1. Size to accommodate burden of contactor coil(s) and all connected auxiliary devices, plus 25% VA spare capacity.

2. Include primary and secondary fuses.

E. Control Terminal Blocks: Include 25 percent spare terminals.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that ratings of enclosed controllers are consistent with the indicated requirements.

C. Verify that mounting surfaces are ready to receive enclosed controllers.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install controllers in accordance with NECA 1 (general workmanship).

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Provide required support and attachment in accordance with Section 26 0529.

E. Install enclosed controllers plumb and level.

F. Provide grounding and bonding in accordance with Section 26 0526.

G. Install all field-installed devices, components, and accessories.

H. Provide fuses complying with Section 26 2813 for fusible switches as indicated.

I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

J. Set field-adjustable controllers and associated components according to installed motor requirements, in accordance with manufacturer's recommendations and NFPA 70.

K. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed in accordance with Section 26 0573.

L. Identify enclosed controllers in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

A. Provide services of a manufacturer's authorized representative to perform start-up and to perform inspection and testing. Include manufacturer's reports with submittals.

B. Inspect and test in accordance with NETA ATS, except Section 4.

C. Motor Starters: Perform inspections and tests listed in NETA ATS, Section 7.16.1.1. Tests listed as optional are not required.

D. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for circuit breakers larger than 400 amperes. Tests listed as optional are not required.

E. Correct deficiencies and replace damaged or defective enclosed controllers or associated components.

F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.4 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

A. Clean dirt and debris from controller enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

3.6 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of controllers to Owner, and correct deficiencies or make adjustments as directed.

B. Training: Train Owner's personnel on operation, adjustment, and maintenance of enclosed controllers and associated devices.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

2. Provide minimum of four hours of training.

3. Instructor: Manufacturer's authorized representative.

4. Location: At project site.

3.7 PROTECTION

A. Protect installed enclosed controllers from subsequent construction operations.

END OF SECTION

SECTION 26 2923 - VARIABLE-FREQUENCY MOTOR CONTROLLER

PART 1 GENERAL

1.1 SUMMARY

A. The Variable Frequency Drive (VFD) system shall contain all components required to meet the performance, protection, safety and certification criteria of this specification.

1.2 RELATED SECTIONS

A. All division 26

B. E-Drawings

1.3 REFERENCES

A. National Fire Protection Association - NFPA 70 - US National Electrical Code.

B. National Electrical Manufacturers Association - NEMA 250 - Enclosures for Electrical Equipment.

C. Underwriters Laboratory Inc. – UL 508.

D. Canadian Standards Association International – CAN/CSA-C22.2 No. 14-05.

E. International Electrical Code - IEC 146.

F. Institute of Electrical and Electronics Engineers, Inc. - IEEE 519 - IEEE Standard Practices and Requirements for Harmonic Control in Electrical Power Systems.

1.4 SUBMITTALS

A. Shop Drawings - Approval

1. Elevation Drawings: Include dimensional information and conduit routing locations.

2. Unit Descriptions: Include amperage ratings, enclosure ratings, fault ratings, nameplate information, etc. as required for approval.

3. Wiring Diagrams:

a. Power Diagram: Include amperage ratings, circuit breaker frame sizes, circuit breaker continuous amp ratings, etc. as required for approval.

b. Control Diagram: Include disconnect devices, pilot devices, etc.

4. Major components list.

B. Product Data Sheets

1. VFD and Operator Interface publications.

2. Data sheets and publications on all major components including but not limited to the following:

a. Contactors

b. Circuit breaker and fuse (power and control)

c. Control power transformers

d. Pilot devices

e. Relays/Timers

C. Test procedures shall be per the manufacturer's standards.

1.5 CLOSEOUT SUBMITTALS (OPERATION AND MAINTENANCE MANUALS)

A. Shop Drawings – Final as shipped

1. Elevation Drawings: Include dimensional information and conduit routing locations.

2. Unit Descriptions: Include amperage ratings, enclosure ratings, fault ratings, nameplate information, etc. as required for approval.

3. Wiring Diagrams:

a. Power Diagram: Include amperage ratings, circuit breaker frame sizes, circuit breaker continuous amp ratings, etc. as required for approval.

b. Control Diagram: Include disconnect devices, pilot devices, etc.

4. Major components list.

B. Product Data Sheets

1. VFD and Operator Interface publications.

2. Data sheets and publications on all major components including but not limited to the following:

a. Contactors

b. Circuit breaker and fuse (power and control)

c. Control power transformers

d. Pilot devices

e. Relays/Timers

C. Test procedures shall be per the manufacturer's standards.

D. Operation and Maintenance Data

1. Service and Contact information

2. VFD and Operator Interface User Manuals

3. Troubleshooting / Service Manuals

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturers:

a. The VFD and all associated optional equipment shall be UL listed or recognized.

b. The VFD shall contain a UL label attached on the inside of the enclosure cabinet.

2. Suppliers:

a. All inspection and testing procedures shall be developed and controlled under the guidelines of the Supplier's quality system and must be registered to ISO 9001 and regularly reviewed and audited by a third-party registrar.

b. The VFD shall be factory pre-wired, assembled and tested as a complete package.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Contractor shall coordinate the shipping of equipment with the manufacturer.

B. Contractor shall store the equipment in a clean and dry space at an ambient temperature range of -40 °C to 70 °C (-40 °F to 158 °F).

C. The contractor shall protect the units from dirt, water, construction debris and traffic.

1.8 WARRANTY

A. The manufacturer shall provide their standard parts warranty for eighteen (18) months from the date of shipment or twelve (12) months from the date of being energized, whichever occurs first.

B. This warranty applies to variable-frequency drive systems.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Allen-Bradley® – PowerFlex® 753 VFD or approved equal

2.2 VARIABLE FREQUENCY DRIVE UNIT

A. Refer to contract drawing for quantity and ratings. Final VFD ratings to be coordianted with actual supplied equipment. Close coordiantion with all trade contractors required.

B. Features

1. Certifications

    a. Listed to UL508C and CAN/CSA-C22.2 No. 14-05

2. Hardware

    a. Utilize diode bridge or SCR bridge on the input rectifier.

    b. Utilize DC bus inductor on all six-pulse VFDs only.

    c. Utilize switching logic power supply operating from the DC bus.

    d. Incorporate phase-to-phase and phase-to-ground MOV protection on the AC input line.

    e. Microprocessor based inverter logic shall be isolated from power circuits.

    f. Utilize latest generation IGBT inverter section.

    g. Battery receptacle for Lithium battery power to the Real-time Clock.

    h. Additional DPI™ port for handheld and remote HIM options.

    i. Dedicated Digital Input for hardware enable.

    j. Conformal coated printed circuit boards.

3. Control Logic

    a. Ability to operate with motor disconnected.

    b. Provide a controlled shutdown, when properly protected, with no component failure in the event of an output phase-to-phase or

phase-to-ground short circuit. Provide annunciation of the fault condition.

c. Provide multiple programmable stop modes including Ramp, Coast, DC-Brake, Ramp-to-Hold, Fast Braking, and Current Limit Stop.

d. Provide multiple acceleration and deceleration rates.

e. Adjustable output frequency up to 590 Hz

4. DeviceLogix™ Control

a. Ability to control outputs and manage status information locally within the VFD.

b. Ability to function standalone or complimentary to supervisory control.

c. Ability to speed reaction time by processing in the VFD.

d. Ability to provide scaling, selector switches, or other data manipulations not already built into the VFD.

e. Ability to read inputs/write outputs and exclusively control the VFD.

f. Ability to provide an option for decision making if communication is lost with main controller.

g. Ability to control other VFDs via a peer-to-peer EtherNet/IP network.

h. Ability to write programs off-line.

5. Motor Control Modes

a. Selectable Sensorless Vector, Flux Vector, V/Hz, and Adjustable Voltage Control modes selectable through programming.

b. The drive shall be supplied with a Start-up and Auto-tune mode.

c. The V/Hz mode shall be programmable for fan curve or full custom patterns.

d. Capable of Open Loop V/Hz.

6. Current Limit

a. Programmable current limit from 20 to 160% of rated output current.

b. Current limit shall be active for all drive states: accelerating, constant speed and decelerating.

c. The drive shall employ PI regulation with an adjustable gain for smooth transition in and out of current limit.

7. Acceleration / Deceleration

    a. Accel/Decel settings shall provide separate adjustments to allow either setting to be adjusted from 0 to 3600 seconds.

    b. A second set of remotely selectable accel/decel settings shall be accessible through digital inputs.

8. Speed Profiles

    a. Programming capability shall allow the user to produce speed profiles with linear acceleration/deceleration or "S Curve" profiles that provide changing accel/decel rates.

    b. S Curve profiles shall be adjustable.

9. Adjustments

    a. A digital interface can be used for all set-up, operation and adjustment settings.

    b. All adjustments shall be stored in nonvolatile memory (EEPROM).

    c. No potentiometer adjustments shall be required.

    d. EEPROM memory for factory default values shall be provided.

    e. Software must be available for trending and diagnostics, as well as online and offline programming functionality.

10. Process PID Control

    a. The drive shall incorporate an internal process PI regulator with proportional and integral gain adjustments as well as error inversion and output clamping functions.

    b. The feedback shall be configurable for normal or square root functions. If the feedback indicates that the process is moving away from the set-point, the regulator shall adjust the drive output until the feedback equals the reference.

    c. Process control shall be capable of being enabled or disabled with a hardwire input. Transitioning in and out of process control shall be capable of being tuned for faster response by preloading the integrator.

    d. Protection shall be provided for a loss of feedback or reference signal.

11. Skip Frequencies

    a. Three adjustable set points that lock out continuous operation at frequencies which may produce mechanical resonance shall be provided.

b. The set points shall have a bandwidth adjustable from Maximum Reverse Speed to Maximum Forward Speed.

12. Fault Reset / Run

    a. When the drive is running or idle it shall provide up to nine automatic fault reset and restarts following a fault condition before locking out and requiring manual restart.

    b. The automatic mode shall not be applicable to shorted output faults and other internal microprocessor faults.

    c. The time between restarts shall be adjustable from 0.5 seconds to 30 seconds.

13. Run on Power Up

    a. A user programmable restart function shall be provided to allow restart of the equipment after restoration of power after long duration power outages. Restart time dependent on presence of incoming signal.

14. Fault Memory

    a. The last 32 fault codes shall be stored and time stamped in a fault buffer.

    b. Information about the drive's condition at the time of the last fault such as operating frequency, output current, dc bus voltage and twenty-seven other status conditions shall be stored.

    c. A power-up marker shall be provided at each power-up time to aid in analyzing fault data.

    d. The last 32 alarm codes shall be stored and time stamped for additional troubleshooting reference.

15. Overload Protection

    a. The drive shall provide internal class 10 adjustable overload protection.

    b. Overload protection shall be speed-sensitive and adjustable.

    c. A viewable parameter shall store the overload usage.

16. Auto Economizer

    a. An auto economizer feature shall be available to automatically reduce the output voltage when the drive is operating in an idle mode (drive output current less than programmed motor FLA). The voltage shall be reduced to minimize flux current in a lightly loaded motor thus reducing kW usage.

b. When the load increases, the drive shall automatically return to normal operation.

17. Terminal Blocks

    a. Separate terminal blocks shall be provided for control and power wiring.

    b. I/O terminal blocks shall be removable with wiring in place.

18. Flying Start

    a. The drive shall be capable of determining the speed and direction of a spinning motor and adjust its output to "pick-up" the motor at the rotating speed. This feature is disabled by default.

19. Inputs and Outputs

    a. The Input / Output option modules shall consist of both analog and digital I/O.

    b. No jumpers or switches shall be required to configure digital inputs and outputs.

    c. All digital input and output functions shall be fully programmable.

    d. The control terminal blocks shall be rated for 115V AC.

    e. Inputs shall be optically isolated from the drive control logic.

    f. The control interface card shall provide input terminals for access to fixed drive functions that include start, stop, external fault, speed, and enable.

    g. The VFD shall be capable of supporting up to 7 analog inputs, 7 analog outputs, 21 digital inputs, 7 relay outputs, 7 transistor outputs, and 3 positive temperature coefficient (PTC) inputs.

    h. The Input / Output option modules shall have the following features:

        1) I/O shall be provided as required by Contract drawings and Drive shall have the capability to add I/O cards for future..

20. Reference Signals

    a. The drive shall be capable of using the following input reference signals:

        1) Analog inputs

        2) Preset speeds

        3) Remote potentiometer

4) Digital MOP

5) Human Interface Module

6) Ethernet I/P

21. Loss of Reference

a. The drive shall be capable of sensing reference loss conditions.

b. In the event of loss of the reference signal, the drive shall be user programmable to the following:

1) Fault the drive and coast to stop.

2) Issue a minor fault - allows the drive to continue running while some types of faults are present.

3) Alarm and maintain last reference.

c. When using a communications network to control the drive, the communications adapter shall have these configurable responses to network disruptions and controller idle (fault or program) conditions:

1) Fault

2) Stop

3) Zero Data

4) Hold Last State

5) Send Fault Configuration

22. Metering

a. At a minimum, the following parameters shall be accessible through the Human Interface Module, if installed:

1) Output Current in Amps

2) Output Voltage in Volts

3) Output Power in kW

4) Elapsed MWh

5) DC Bus Voltage

6) Frequency

7) Heatsink Temperature

8) Last eight (32) faults

9) Elapsed Run Time

10) IGBT Temperature

23. Faults

    a. At a minimum, the following faults shall be accessible through the Human Interface Module:

        1) Power Loss

        2) Undervoltage

        3) Overvoltage

        4) Motor Overload

        5) Heat Sink Over-temperature

        6) Maximum Retries

        7) Phase-to-phase and Phase to Ground Faults

24. Predictive Diagnostics

    a. At a minimum, the following predictive diagnostic features shall be provided:

        1) Relay Output Life Cycles based on load type and amps.

        2) Hours of Fan Life based on load and ambient temperature.

        3) Motor Bearing life based on expected hours of use.

        4) Motor Lubrication schedule based on hours of use.

        5) Machine Bearing life based on expected hours of use.

25. Real-time Clock

    a. Shall be capable of providing time stamped events.

    b. Shall have the ability to be set locally or via a remote controller.

    c. Shall provide the ability to be programmable for month, day, year and local time zones in HH:MM:SS.

26. Programmable Logic Controller Integration

a. The drive shall have the following specific features to enable integration with a Rockwell Automation® ControlLogix® or CompactLogix™ Automation Controller

1) Shall have an Add-on Profile available for use with Rockwell Automation Studio 5000® programming software

2) Shall support Rockwell Automation controller's Automatic Device Configuration functionality

2.3 VFD PACKAGED SYSTEM

A. Features

1. Ratings

a. Voltage

1) Capable of accepting nominal plant power of 480 at 60 Hz.

2) The supply input voltage tolerance shall be ± 10% of nominal line voltage.

b. Displacement Power Factor

1) Six-pulse VFD shall be capable of maintaining a minimum true power factor (Displacement P.F. X Distortion P.F.) of 0.95 or better at rated load and nominal line voltage, over the entire speed range.

2) Efficiency

3) A minimum of 96.5% (+/- 1%) at 100% speed and 100% motor load at nominal line voltage.

4) Control power supplies, control circuits, and cooling fans shall be included in all loss calculations.

c. Operating ambient temperature range without derating: 0 °C to 40 °C (32 °F to 104 °F)

d. Operating relative humidity range shall be 5% to 95% non-condensing.

e. Operating elevation shall be up to 1000 Meters (3,300 ft) without derating.

2. Sizing

a. Systems rated at Normal Duty or Variable torque loads shall provide 110% overload capability for up to one minute and 150% for up to 3 seconds.

b. Systems rated at Heavy-Duty or constant torque loads shall provide 150% overload capability for up to one minute and 180% for up to 3 seconds.

3. Auto Reset/Run

    a. For faults other than those caused by a loss of power or any other non-critical fault, the drive system shall provide a means to automatically clear the fault and resume operation.

4. Ride-Through

    a. The VFD system shall attempt to ride through power dips up to 20% of nominal. The duration of ride-through shall be inversely proportional to load. For outages greater than 20%, the drive shall stop the motor and issue a power loss alarm signal to a process controller, which may be forwarded to an external alarm signaling device.

5. Run on Power Up

    a. The VFD system shall provide circuitry to allow for remote restart of equipment after a power outage. Unless indicated in the contact drawings, faults due to power outages shall be remotely resettable. The VFD system shall indicate a loss of power to a process controller, which may be forwarded to an external alarm signaling device. Upon indication of power restoration the process controller will attempt to clear any faults and issue a run command, if desired.

6. Communications

    a. VFD shall be capable of communicating on multiple networks.

    b. VFD shall be capable of supporting the following network options:

        1) EtherNet/IP™

7. Enclosure Door Mounted Human Interface Module (HIM)

    a. VFD shall provide a HIM with integral LCD display, operating keys and programming keys.

    b. An enclosure door-mounted HIM, rated NEMA/UL Type 1 or NEMA/UL Type 4/12, shall be provided

    c. The HIM shall have the following features:

        1) A three (3) line by twenty-one (21) character backlit LCD display with graphics capability.

        2) Shall indicate drive operating conditions, adjustments and fault indications.

3) Shall be configured to display in the following three distinct zones:

(a) The top zone shall display the status of direction, drive condition, fault / alarm conditions and Auto / Manual mode.

(b) The middle zone shall display drive output frequency.

(c) The bottom zone shall be configurable as a display for either programming menus / information or as a two-line user display for two additional values utilizing scaled units.

4) Shall provide digital speed control.

5) The keypad shall include programming keys, drive operating keys (Start, Stop, Direction, Jog and Speed Control), and numeric keys for direct entry.

B. Enclosure

1. Shall be rated NEMA/UL Type (1G) per the MCC specification

2. Shall be painted per the manufacturer's standard.

3. Shall provide entry and exit locations for power cables.

4. Drive shall contain a label indicating certification to UL in accordance with UL508C compliance

5. The drive system nameplate shall be marked with system Short Circuit Current Rating (SCCR).

C. Drive Enclosure Input Disconnect

1. Provide an enclosure door interlocked disconnect with disconnect

2. Operator Handles

a. Provide externally operated main disconnect handle.

b. Handles shall be lockable with up to three lockout / tagout padlock positions.

D. Branch Circuit Protection

1. Input fusing, motor circuit protector (MCP), or inverse time circuit breaker shall be provided

2. Provide a control power transformer mounted and wired inside of the drive system enclosure.

3. The transformer shall be rated for the VFD power requirements.

E. Harmonic Mitigation Techniques

1. Drive Input Line Reactor

a. Provide a drive input line reactor mounted within the drive system enclosure.

b. The line reactor shall meet the following specifications:

1) The construction shall be iron core with an impedance of 3 percent

2) The winding shall be copper

3) The insulation shall be Class H with a 115 °C rise over 50 °C ambient.

4) The unit shall be rated for system voltage, ampacity, and frequency.

c. The drive system shall be compliant with IEEE519-1992 standards at the Point of Common Coupling (utility service connection

F. Auxiliary Relays

1. Provide relays for Drive Alarm, Drive Fault, Drive Run, and System Status Faults (as required).

2. The relays shall be Allen-Bradley® 700-HC (2 N.O. & 2 N.C.). The relay contacts shall be rated for 115V AC/30V DC, 5.0 amp resistive, 2.5 amp inductive.

G. Control Interface

1. The control terminals shall be rated for 115V AC.

2. The control interface shall provide input terminals for access to VFD functions that include start, stop, external fault, speed select, and enable, as required.

H. Pilot Lights and devices

1. Provide LED pilot lights and devices, mounted on the enclosure dooras shown on contract drawings

I. Motor Runtime Meter

1. Provide a digital, non-resettable, door-mounted elapsed time meter.

2. The meter shall be electrically interlocked with the Drive Run relay to indicate actual motor operating hours.

J. Output Filtering (as required based on manufacturers listed motor lead lengths)

1. 3% output line reactor

2. 1321 Reflected Wave Reduction (RWR) output filter

3. DV/DT output filter (may affect the system SCCR rating)

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that location is ready to receive equipment.

B. Verify that the building environment can be maintained within the service conditions required by the manufacturer of the VFD.

3.2 INSTALLATION

A. Installation shall be in compliance with all manufacturer requirements, instructions and drawings.

3.3 START-UP SERVICE

A. At a minimum, the start-up service shall include:

1. Perform pre-Power Check

2. Megger Motor Resistances: Phase-to-Phase and Phase-to-Ground

3. Verify system grounding per manufacturer’s specifications

4. Verify power and signal grounds

5. Check connections

6. Check environment

B. Drive Power-up and Commissioning:

1. Measure Incoming Power Phase-to-Phase and Phase-to-Ground

2. Measure DC Bus Voltage

3. Measure AC Current Unloaded and Loaded

4. Measure Output Voltage Phase-to-Phase and Phase-to-Ground

5. Verify input reference signal

C. All measurements shall be recorded.

D. Drive shall be tuned for system operation.

E. Drive parameter listing shall be provided.

F. Include at minimum five (5) days of on-site start-up services from a manufacturer's authorized representative.

3.4 TRAINING

A. Provide at minimum one (1) day of on-site training from a manufacturer's authorized representative.

END OF SECTION

SECTION 26 3213 - ENGINE GENERATORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Under this section the Contractor shall furnish all labor, materials, equipment, and accessories for the diesel emergency generator system as shown on the plans and specified herein.

B. Packaged engine generator system to include but not limted to the following:

1. Waste Water Treatment Plant (WWTP) - Parallel Unit Configuration

a. 750kW, 480Y/277V, 3 phase, 4-wire diesel generator unit, 12 lead reconnectable alternator.

b. Load Control Module

c. 48-hour (min.) sub-base diesel fuel tank.

d. Weather and sound attenuated Level 1 enclosure.

e. Loadcenter within enclosure.

f. Portable stairs and handrail for control panel access and routine maintenance.

g. Remote emergency stop button

h. Remote annunciator & display

i. Spill Kit.

j. Exhaust piping and muffler.

k. Batteries and charger.

l. Block heater.

m. Alternator (generator).

n. Generator set control system.

o. Installation, initial startup, and training.

C. Contractor to provide temporary trailer-mounted generator(s) for temporary power provisions as required. Contractor to field verify and provide as required to maintain all facilities throughout the project duration. Refer to Section 26 0510 - Basic Electrical Requirements and Contract Drawings for additional information as it pertains to providing temporary power.

D. This specification and associated work shall also include all controls, accessories, appurtenances, or other such work required for a complete operating emergency generator system.

1.2 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 26 3600 - Transfer Switches.

1.3 REFERENCE STANDARDS

A. ASTM D975 - Standard Specification for Diesel Fuel Oils; 2015b.

B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

C. NECA/EGSA 404 - Standard for Installing Generator Sets; 2014.

D. NEMA MG 1 - Motors and Generators; 2014.

E. NFPA 30 - Flammable and Combustible Liquids Code; 2015.

F. NFPA 37 - Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines; 2015.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. NFPA 99 - Health Care Facilities Code; 2015.

I. NFPA 110 - Standard for Emergency and Standby Power Systems; 2013.

J. UL 142 - Steel Aboveground Tanks for Flammable and Combustible Liquids; Current Edition, Including All Revisions.

K. UL 1236 - Battery Chargers for Charging Engine-Starter Batteries; Current Edition, Including All Revisions.

L. UL 2200 - Stationary Engine Generator Assemblies; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate compatibility of generator sets to be installed with work provided under other sections or by others.

    a. Transfer Switches: See Section 26 3600. Transfer switch and engine generators to be provided by the same manufacturer.

2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment or other potential obstructions within the spaces dedicated for engine generator system.

3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.

4. Coordinate the work to provide electrical circuits suitable for the power requirements of the actual auxiliary equipment and accessories to be installed.

5. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Preinstallation Meeting: Convene one week before starting work of this section; require attendance of all affected installers.

1.5 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features. Include alternator starting capabilities, engine fuel consumption rates, and cooling, combustion air, and exhaust requirements.

1. Include generator set sound level test data.

2. Include characteristic trip curves for overcurrent protective devices.

3. Include alternator thermal damage curve.

B. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.

C. Fuel Storage Tank Calculations: Indicate maximum running time for generator set configuration provided.

D. Specimen Warranty: Submit sample of manufacturer's warranty.

E. Evidence of qualifications for installer.

F. Evidence of qualifications for maintenance contractor (if different entity from installer).

G. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.

H. Manufacturer's factory emissions certification. Showing compliance with EPA emissions requirements.

I. Manufacturer's certification that products meet or exceed specified requirements.

J. Source quality control test reports.

K. Provide NFPA 110 required documentation from manufacturer, including but not limited to:

1. Certified prototype tests.

2. Torsional vibration compatibility certification.

3. NFPA 110 compliance certification.

4. Certified rated load test at rated power factor.

L. Manufacturer’s detailed field testing procedures.

M. Field quality control test reports.

N. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.

1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.

O. Executed Warranty: Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.

P. Maintenance contract.

Q. Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.

R. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Filter Elements: Two of each type, including fuel, oil and air.

1.6 QUALITY ASSURANCE

A. Comply with the following:

1. NFPA 70 (National Electrical Code).

2. NFPA 110 (Standard for Emergency and Standby Power Systems).

3. NFPA 37 (Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines).

4. NFPA 30 (Flammable and Combustible Liquids Code).

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1. Authorized service facilities located within 200 miles of project site.

D. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience with engine generator systems of similar size, type, and complexity; manufacturer's authorized installer.

E. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.

1. Contract maintenance office located within 200 miles of project site.

F. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

G. The emergency power system supplier (EPSS) shall be an authorized service provider for all components of the emergency power system (EPS). To assure maximum equipment uptime and best service response to the Owner, the EPSS shall be a factory authorized dealer with complete EPS parts and service available on a 24-hour emergency basis within a 200-mile radius of the project site.

H. For the equipment specified herein, the manufacturer local dealer representative shall be ISO 9001 or 9002 certified.

I. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided, demonstrating compliance with this requirement.

J. The generator set supplier shall have sufficient parts inventory to maintain over-the-counter availability of at least 90 percent of any required parts. The generator set supplier shall guarantee 97 percent parts availability within 24 hours and 100 percent within 48 hours from the time an order is entered with the dealer.

K. The manufacturer’s dealer shall stock and own a fleet of rental generators and transfer switches in the event a temporary unit is required due to failure of supplied unit.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store generator sets in accordance with manufacturer's instructions and NECA/EGSA 404.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's instructions to avoid damage to generator set components, enclosure, and finish.

1.8 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

A. Provide minimum five year manufacturer warranty covering repair or replacement due to defective materials or workmanship. Warranty coverage shall include all parts, labor, and travel expenses.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Packaged Engine Generator Set - Basis of Design: CUMMINS Power Generation (ONAN).

1. WWTP - Cummins Model DQCB

a. Note, two (2) units required at this site. Parellel units together.

B. Packaged Engine Generator Set Acceptable Manufacturers - Other Acceptable Manufacturers:

1. Caterpillar Inc: www.cat.com.

2. Kohler Co: www.kohlerpower.com.

C. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.

D. Source Limitations: Furnish engine generator sets and associated components and accessories produced by a single manufacturer and obtained from a single supplier.

2.2 PACKAGED ENGINE GENERATOR SYSTEM

A. Provide new engine generator systems consisting of all required equipment, sensors, conduit, boxes, wiring, piping, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. System Description:

1. Application: Emergency/standby.

2. WWTP Configuration: Multiple packaged engine generator sets operated in parallel. All paralelling to be accomplished with on-board controls. No dedicated paralleling equipment/gear desired.

3. Where design is based on multiple parallel generator sets, use of fewer, larger unit(s) to obtain equivalent total system power rating is not permitted.

D. Packaged Engine Generator Set:

1. Type: Diesel (compression ignition).

2. Power Ratings: As indicated below, standby.

    a. WWTP - Parallel 750kW units

3. Voltage: 480Y/277 V, 3 phase, 60 Hz.

4. Engine Speed: 1800RPM

5. Main Line Circuit Breaker:

    a. Type: Electronic trip with long time and short time delay and instantaneous pickup.

    b. Trip Rating: As indicated on drawings.

    c. 100% rated, UL listed

    d. Electrically operated for paralleling at WWTP, alternative methods of paralleling is not acceptable.

6. The engine shall be manufactured in North America

E. Generator Set General Requirements:

1. Prototype tested in accordance with NFPA 110 for Level 1 systems.

2. Factory-assembled, with components mounted on suitable base.

3. List and label engine generator assembly as complying with UL 2200.

4. Power Factor: Unless otherwise indicated, specified power ratings are at 0.8 power factor for three phase voltages and 1.0 power factor for single phase voltages.

5. Provide suitable guards to protect personnel from accidental contact with rotating parts, hot piping, and other potential sources of injury.

6. Main Line Circuit Breakers: Provide factory-installed line side connections with suitable lugs for load side connections.

    a. Provide unit mounted circuit breaker with lugs suitable for terminating conductors specified on the Contract Drawings.

F. Service Conditions: Provide engine generator system and associated components suitable for operation under the service conditions at the installed location.

G. Starting and Load Acceptance Requirements:

1. Cranking Method: Cycle cranking complying with NFPA 110 (15 second crank period, followed by 15 second rest period, with cranking limiter time-out after 3 cycles), unless otherwise required.

2. Cranking Limiter Time-Out: If generator set fails to start after specified cranking period, indicate overcrank alarm condition and lock-out generator set from further cranking until manually reset.

3. Start Time: Capable of starting and achieving conditions necessary for load acceptance within 10 seconds (NFPA 110, Type 10).

4. Maximum Load Step: Supports 100 percent of rated load in one step.

5. Unit shall be capable of continuous full power service at rated output for duration of standby service.

6. Motor Starting Capability: Supports starting of motor load indicated with a maximum voltage dip of 25 percent.

H. Exhaust Emissions Requirements:

1. Comply with federal (EPA), state, and local regulations applicable at the time of commissioning; include factory emissions certification with submittals.

2. The proposed generator sets shall be EPA Certified per the below outline and in compliance with the State of New York Emission regulations at the time of installation/commissioning. Actual engine emissions values must be in compliance with EPA emissions standards per ISO 8178 - D2 Emissions Cycle at specified ekW /bHP rating. Utilization of the "Transition Program for

Equipment Manufacturers " also know as “Flex Credits” to achieve the below tier certification is not acceptable.

a. WWTP - Tier 2 Certified

3. Do not make modifications affecting generator set factory emissions certification without approval of manufacturer and Engineer. Where such modifications are made, provide field emissions testing as necessary for certification.

I. Spill cleanup materials and cabinet:

1. Contractor to provide spill kit in high-visibility mobile container, model "KIT273" as manufactured by PIG or approved equal.

2. Spill kit to absorb up to 37 gallons and ability to absorb oils, coolants, solvents, water, etc. (universal kit). All kit contents to be prepackaged within mobile container.

3. Coordinate final location with the owner for the spill kit to be placed. Provide label at generator with location of spill kit.

J. Generator manufacturer to provide as part of the package a portable stair and handrail system as required to access engine control panel. It is assummed the engine mounted control panel will be to high off finished grade for an average height person to monitor/control the engine. Contractor to field verify and provide 60" high portable stair/handrail system as required.

K. Contractor to provide remote Emergency Stop button and remote annunciator and display as specified on the Contract Drawings.

L. Generator Enclosure Load Center:

1. Provide 100A, 240V, 1-phase, 3-wire, 22KAIC rated loadcenter within generator enclosure. Provide with 100 amp main circuit breaker and within a NEMA 4X enclosure.

2. Loadcenter to be factory installed within generator enclosure.

3. Provide branch breakers as required to serve generator accessories.

4. All generator accessories to be factory wired and terminated to loadcenter. All requirements to be per NEC.

M. Sound Level Requirements:

1. Provide weather protective and sound attenuated (level 1) enclosure for each specified engine generator system.

2.3 ENGINE AND ENGINE ACCESSORY EQUIPMENT

A. Provide engine with adequate horsepower to achieve specified power output at rated speed, accounting for alternator efficiency and parasitic loads.

1. The engine shall be 4 cycle with forged steel crankshaft and connecting rods. The cylinder block shall be cast iron.

2. Two cycle engines are not acceptable.

B. Engine Fuel System - Diesel (Compression Ignition):

1. Fuel Source: Diesel, ASTM D975 No. 2-D or approved cold weather diesel blends.

2. Fuel Storage: Sub-base fuel tank.

3. Engine Fuel Supply: Provide engine-driven, positive displacement fuel pump with replaceable fuel filter(s), water separator, check valve to secure prime, manual fuel priming pump, and relief-bypass valve.

4. Engine Fuel Connections: Provide suitable, approved flexible fuel lines for coupling engine to fuel source.

5. Sub-Base Fuel Tank:

a. Provide sub-base mounted, double-wall fuel tank with secondary containment; listed and labeled as complying with UL 142.

b. Tank Capacity: Size for minimum of 48 hours of continuous engine generator operation at 100 percent rated load, but not larger than permissible by applicable codes.

1) Contractor is responsible for necessary spill prevention plan as required per local code, regulations, etc. Coordinate final requirements closely with the owner

c. Sub-base fuel tank to be comply with all applicable federal, EPA, and local codes/standards.

d. Contractor responsible for initial fill of all fuel storage tanks for each engine generator system specified.

e. Features:

1) Direct reading fuel level gauge.

2) Normal atmospheric vent.

3) Emergency pressure relief vent.

4) Fuel fill opening with lockable cap.

5) Dedicated electrical conduit stub-up area.

6) Low fuel level switch.

7) Leak detection switch; located within secondary containment interstitial space for detection of primary tank fuel leak.

C. Engine Starting System:

1. System Type: Electric, with DC solenoid-activated starting motor(s).

2. Battery(s):

a. Battery Type: Lead-acid.

b. Battery Capacity: Size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature; capable of providing cranking through three complete periods of cranking limiter time-outs without recharging.

c. Provide battery rack, cables, and connectors suitable for the supplied battery(s); size battery cables according to manufacturer's recommendations for cable length to be installed.

3. Battery-Charging Alternator: Engine-driven, 25 ampere minimum, and with integral solid-state voltage regulation.

4. Supply generator set with battery charger.

5. Battery Charger:

a. Provide dual rate battery charger with automatic float and equalize charging modes and minimum rating of 10 amps; suitable for maintaining the supplied battery(s) at full charge without manual intervention.

b. Capable of returning supplied battery(s) from fully discharged to fully charged condition within 24 hours, as required by NFPA 110 for Level 1 applications while carrying normal loads.

c. Listed as complying with UL 1236.

d. Furnished with integral overcurrent protection; current limited to protect charger during engine cranking; reverse polarity protection.

e. Provide integral DC output ammeter and voltmeter with five percent accuracy.

f. Provide alarm output contacts as necessary for alarm indications.

g. Battery charger to installed within the generator enclosure.

h. Provide factory circuitry to loadcenter.

6. Battery Heater: Provide thermostatically controlled battery heater to improve starting under cold ambient conditions.

D. Engine Speed Control System (Governor):

1. Multiple Engine Generator Sets Operated in Parallel: Provide electronic isochronous governors with automatic load sharing controls.

2. Frequency Regulation, Electronic Isochronous Governors: No change in frequency from no load to full load; plus/minus 0.25 percent at steady state.

E. Engine Lubrication System:

1. System Type: Full pressure, with engine-driven, positive displacement lubrication oil pump, replaceable full-flow oil filter(s), and dip-stick for oil level indication.

2. Oil Heater: Provide thermostatically controlled oil heater to improve starting under cold ambient conditions. Provide factory circuitry to loadcenter.

F. Engine Cooling System:

1. System Type: Closed-loop, liquid-cooled, with unit-mounted radiator/fan and engine-driven coolant pump; suitable for providing adequate cooling while operating at full load under worst case ambient temperature.

2. The cooling system shall be filled with 50/50 ethylene glycol/water mixture by the equipment manufacturer.

3. Fan Guard: Provide suitable guard to protect personnel from accidental contact with fan.

4. Coolant Heater: Provide thermostatically controlled coolant heater to improve starting under cold ambient conditions; size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature. Coolant heater to be rated 208 volt, single phase. Provide factory circuitry to loadcenter.

G. Exhaust System:

1. Exhaust muffler shall be provided, size and type as recommended by the generator set manufacturer. The muffler shall be critical silence grade.

H. Base:

1. The engine/generator set shall be mounted on a heavy duty steel base to maintain proper alignment between components. The engine/generator set shall

incorporate a corrosion resistant battery tray with battery hold-down clamps within the base rails. Provisions for stub up of electrical and fuel connections shall be within the footprint of the generator set base rails.

2. Oil drain and coolant drain lines shall be extended to outside of generator support steel base for ease of maintenance purposes.

3. Spring vibration isolators are to be provided. Provide quantity, size, and type as recommended by generator manufacturer.

4. Contractor to anchor generator base to the proposed concrete pad per the generator manufacturer's recommendations.

I. Engine Air Intake and Exhaust System:

1. Air Intake Filtration: Provide engine-mounted, replaceable, dry element filter.

2. Engine Exhaust Connection: Provide suitable, approved flexible connector for coupling engine to exhaust system. Refer to Contract Drawings for additional information.

2.4 ALTERNATOR (GENERATOR)

A. Alternator: 4-pole, 1800 rpm (60 Hz output) revolving field, synchronous generator complying with NEMA MG 1; connected to engine with flexible coupling; voltage output configuration as indicated, with reconnectable leads for 3 phase alternators.

B. Exciter:

1. Exciter Type: Brushless; provide permanent magnet generator (PMG) excitation system; self-excited (shunt) systems are not permitted.

2. PMG Excitation Short-Circuit Current Support: Capable of sustaining 300 percent of rated output current for 10 seconds.

3. Voltage Regulation (with PMG excitation): Plus/minus 0.5 percent for any constant load from no load to full load.

C. Temperature Rise: 105 degrees celsius and Comply with UL 2200.

D. Insulation System: NEMA MG 1, Class H; suitable for alternator temperature rise.

E. Enclosure: NEMA MG 1, drip-proof.

F. Total Harmonic Distortion: Not greater than five percent.

2.5 GENERATOR SET CONTROL SYSTEM

A. Provide microprocessor-based control system for automatic control, monitoring, and protection of generator set. Include sensors, wiring, and connections necessary for functions/indications specified.

1. Generator units at the WWTP site to be provided with on-board paralleing controls. Configure units for parallel operation. Coordinate final parameters and configuration with the owner/engineer during statup and acceptance testing.

2. Load Demand, provide controls to shut one generator down as the load on the system decrease and restarts as the bus demand increases.

B. Provide a fully redundant remote generator HMI mounted within the MBR Building as shown on the contract drawings. This HMI shall be identical to the generator set mounted HMI and display all operating parameters and functions of the set mounted HMI. Contractor to provide a Belden 9729 cable between the two displays for connection.

C. Remote Emergency Stop: Provide approved red, mushroom style remote emergency stop button where indicated on the Contract Drawings. Provide cabling from generator system to emergency stop button as indicated on the drawings.

D. A UL listed comprehensive monitoring and control system integral to the control system that guards the electrical integrity of the alternator and power system by providing protection against a wide array of fault conditions in the generator set or in the load. It also provides single and three phase fault current regulation so that downstream protective devices have the maximum current available to quickly clear fault conditions without subjecting the alternator to potentially catastrophic failure conditions.

E. Provide Load Control Module, part number A061Z711 as manufactured by Cummins or approved equal. Load control module to be utilized to control/shed load when required. Refer to contract drawings for additional information.

1. 7" touch screen

2. Will support up to 4 generator sets and 8 loads

3. Displays all generator, engine & alternator related parameters. Users have the ability to add virtual analog gauges for a limited set of parameters.

4. Displays System Metering data for all source breakers. Metering includes 1% of accuracy for voltage and current measurements

5. Collects and displays real-time and historical data on total kW, total kVAR, average amps, average voltage, and frequency data from the generators

6. Displays all active or unacknowledged alarms along with timestamped events.

7. Provide real-time overview of all systems components monitored by the LCM.

8. Displays status of each load level (Added, Shed, Restored) and allows Manual Add/Shed capability per respective load.

F. Control Panel:

1. Control Panel Mounting: Unit-mounted unless otherwise indicated; vibration isolated.

2. Generator Set Control Functions:

    a. Automatic Mode: Initiates generator set start/shutdown upon receiving corresponding signal from remote device (e.g. automatic transfer switch).

    b. Manual Mode: Initiates generator set start/shutdown upon direction from operator.

    c. Reset Mode: Clears all faults, allowing generator set restart after a shutdown.

    d. Emergency Stop: Immediately shuts down generator set (without time delay) and prevents automatic restarting until manually reset.

    e. Cycle Cranking: Programmable crank time, rest time, and number of cycles.

        1) Initial programming shall be for 3 cranking periods of 15 seconds each, with 15 second rest period between cranking periods.

    f. Time Delay: Programmable for shutdown (engine cooldown) and start (engine warmup).

    g. Voltage Adjustment: Adjustable through range of plus/minus 5 percent.

3. Generator Set Status Indications:

    a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.

    b. Current (Amps): For each phase.

    c. Frequency (Hz).

    d. Real power (W/kW).

    e. Reactive power (VAR/kVAR).

    f. Apparent power (VA/kVA).

    g. Power factor.

    h. Duty Level: Actual load as percentage of rated power.

    i. Engine speed (RPM).

    j. Battery voltage (Volts DC).

    k. Engine oil pressure.

    l. Engine coolant temperature.

m. Engine run time.

n. Generator powering load (position signal from transfer switch).

4. Generator Set Protection and Warning/Shutdown Indications:

   a. Comply with NFPA 110; configurable for NFPA 110 Level 1 or Level 2, or NFPA 99 systems including but not limited to the following protections/indications:

      1) Overcrank (shutdown).

      2) Low coolant temperature (warning).

      3) High coolant temperature (warning).

      4) High coolant temperature (shutdown).

      5) Low oil pressure (shutdown).

      6) Overspeed (shutdown).

      7) Low fuel level (warning).

      8) Low coolant level (warning/shutdown).

      9) Generator control not in automatic mode (warning).

      10) High battery voltage (warning).

      11) Low cranking voltage (warning).

      12) Low battery voltage (warning).

      13) Battery charger failure (warning).

   b. In addition to NFPA 110 requirements, provide the following protections/indications:

      1) High AC voltage (shutdown).

      2) Low AC voltage (shutdown).

      3) High frequency (shutdown).

      4) Low frequency (shutdown).

      5) Overcurrent (shutdown).

      6) Fuel tank leak (warning), where applicable.

c. Provide (4) N.O and (4) N.C. contacts for remote control/monitoring of the following: generator running indication, generator available indication, generator warning indication (alarm condition that allows generator to continue running), and generator fault indication (alarm condition that causes generator to shutdown). The dry contact outputs shall be programmed and verified by the manufacturer's onsite representative during startup and acceptance testing after installation of the emergency generator system. Final requirements to be coordinated with the owner.

d. Provide lamp test function that illuminates all indicator lamps.

5. Other Control Panel Features:

a. Event log.

b. 120VAC control panel heater if required by manufacturer. Contractor responsible for all circuiting if required.

c. The alternator shall be provided with an overcurrent protection relay that is UL-listed under category NRGU. The overcurrent protection system shall be coordinated with the thermal damage curve of the specific alternator provided. Submit thermal damage curve for alternator and protection curve (and settings if applicable) for the overcurrent protective system.

d. Communications Capability: Compatible with system indicated. Provide all accessories necessary for proper interface.

2.6 TEMPORARY POWER:

A. Contractor to provide a temporary trailer mounted diesel generator set(s) to provide power to each facility throughout the duration of the project as required.

1. Refer to specification section 26 05 10 and contract drawings for additional information.

2.7 GENERATOR SET ENCLOSURE

A. Enclosure Type: Sound attenuating, weather protective.

B. Enclosure Material: Steel or aluminum.

C. Hardware Material: Stainless steel.

D. Color: Manufacturer's standard.

E. Access Doors: Lockable, with all locks keyed alike.

F. Openings: Designed to prevent bird/rodent entry.

G. External Drains: Extend oil and coolant drain lines to exterior of enclosure for maintenance service.

H. Sound Attenuating Enclosures: Line enclosure with non-hydroscopic, self-extinguishing sound-attenuating material.

I. Provide loadcenter per above article.

J. Contractor to provide ladder and working platform (including all installation hardware) around generator if subbase fuel storage tank exceeds 34 inches in height. Platform to allow personnel to easily access the generator for maintenance/inspection purposes.

1. Submit proposed solution to engineer for approval.

2. Final requirements to be closely coordinated with the owner and engineer.

2.8 SOURCE QUALITY CONTROL

A. Perform production tests on generator sets at factory to verify operation and performance characteristics prior to shipment. Include certified test report with submittals.

B. Generator Set production testing to include, at a minimum:

1. Operation at rated load and rated power factor.

2. Single step load pick-up.

3. Transient and steady state voltage and frequency performance.

4. Operation of safety shutdowns.

C. Diesel Fuel Storage Tanks: Perform pressurized leak test prior to shipment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of generator sets and auxiliary equipment are consistent with the indicated requirements.

C. Verify that rough-ins for field connections are in the proper locations.

D. Verify that mounting surfaces are ready to receive equipment.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Install generator sets and associated accessories in accordance with NECA/EGSA 404, NFPA 70, and manufacturers recommendations.

D. Arrange equipment to provide minimum clearances and required maintenance access. Refer to Contract Drawings for additional information.

E. Unless otherwise indicated, mount generator set on properly sized 12 inch high concrete padas indicated on the drawings. Provide suitable vibration isolators, where not factory installed.

F. Provide required support and attachment in accordance with Section 26 0529.

G. Use manufacturer's recommended oil and coolant, suitable for the worst case ambient temperatures.

H. Provide grounding and bonding in accordance with Section 26 0526.

I. Identify system wiring and components in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

A. Provide services of a manufacturer's authorized representative to prepare and start systems and perform inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.

B. Notify Owner and Engineer at least two weeks prior to scheduled inspections and tests.

C. Contractor is responsible for registering fuel storage tank as required per local code/regulations and authority having jurisdiction.

D. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.

E. Provide all equipment, tools, and supplies required to accomplish inspection and testing, including load bank and fuel.

F. Preliminary inspection and testing to include, at a minimum:

1. Inspect each system component for damage and defects.

2. Verify tightness of mechanical and electrical connections are according to manufacturer's recommended torque settings.

3. Check for proper oil and coolant levels.

G. Prepare and start system in accordance with manufacturer's instructions.

H. Perform acceptance test in accordance with NFPA 110.

I. Inspection and testing to include, at a minimum:

1. Verify compliance with starting and load acceptance requirements.

2. Verify voltage and frequency; make required adjustments as necessary.

3. Verify phase sequence.

4. Verify control system operation, including safety shutdowns.

5. Verify operation of auxiliary equipment and accessories (e.g. battery charger, heaters, etc.).

6. Perform load tests in accordance with NFPA 110 (1.5 hour building load test followed by 2 hour full load test). Contractor to supply a load bank and cabling as neccessary in order to perform the full load test.

J. Provide field emissions testing where necessary for certification.

K. Sound Level Tests: Measure sound levels for compliance with specified requirements. Identify and report ambient noise conditions.

L. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

M. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the main service disconnect, and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with the owner. Provide 2 weeks notice and coordiante with the owner.

N. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.4 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.5 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of system to Owner, and correct deficiencies or make adjustments as directed.

1. Refer to 26 3600 for additional requirements.

B. Training: Train Owner's personnel on operation, adjustment, and maintenance of system.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

2. Provide minimum of four hours of training.

3. Instructor: Manufacturer's authorized representative.

4. Location: At project site.

C. After successful acceptance test and just prior to Substantial Completion, replace air, oil, and fuel filters and fill fuel storage tank.

3.6 PROTECTION

A. Protect installed engine generator system from subsequent construction operations.

3.7 MAINTENANCE

A. Provide to Owner at no extra cost, a separate maintenance contract for the service and maintenance of each engine generator system for two years from date of Substantial Completion; Include a complete description of preventive maintenance, systematic examination, adjustment, inspection, and testing, with a detailed schedule. Contractor to include these services for all specified engine generator systems.

1. Maintenance contract to include testing the emergency genertor at full load (2-hour full load test). Manufacturer required to provide necessary load bank and cabling.

B. Conduct site visit at least once every six months to perform inspection, testing, and preventive maintenance at each site. Submit report to Owner indicating maintenance performed along with evaluations and recommendations.

C. Provide trouble call-back service upon notification by Owner:

1. Provide on-site response within 4 hours of notification.

2. Include allowance for call-back service during normal working hours at no extra cost to Owner.

3. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.

D. Maintain an on-site log listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced.

END OF SECTION

SECTION 26 3600 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Transfer switches for low-voltage (600 V and less) applications and associated accessories:

1. Automatic transfer switches. Refer to Contract Drawings for additional information.

1.2 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 26 0573 - Power System Studies: Additional criteria for the selection of equipment specified in this section.

E. Section 26 2100 - Low-Voltage Electrical Service Entrance.

F. Section 26 2818 - Enclosed Switches: Safety switches not listed for use as transfer switch equipment.

G. Section 26 3213 - Engine Generators: For interface with transfer switches.

1. Includes additional testing requirements.

2. Includes related demonstration and training requirements.

1.3 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

C. NEMA ICS 10 Part 1 - Industrial Control and Systems Part 1: Electromechanical AC Transfer Switch Equipment; 2005.

D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.

E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

F. UL 1008 - Transfer Switch Equipment; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate compatibility of transfer switches to be installed with work provided under other sections or by others.

    a. Engine Generators: See Section 26 3213.

2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.

3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.

4. Coordinate the work with placement of supports, anchors, etc. required for mounting.

5. Notify Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features.

B. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.

C. Specimen Warranty: Submit sample of manufacturer's warranty.

D. Evidence of qualifications for installer.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.

F. Manufacturer's certification that products meet or exceed specified requirements.

G. Source quality control test reports.

H. Manufacturer’s detailed field testing procedures.

I. Field quality control test reports.

J. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.

K. Executed Warranty: Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.

L. Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.

1.6 QUALITY ASSURANCE

A. Comply with the following:

1. NFPA 70 (National Electrical Code).

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience with power transfer systems of similar size, type, and complexity; manufacturer's authorized installer.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store transfer switches in accordance with manufacturer's instructions.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle carefully in accordance with manufacturer's instructions to avoid damage to transfer switch components, enclosure, and finish.

1.8 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

A. Provide minimum two year manufacturer warranty covering repair or replacement due to defective materials or workmanship. Warranty shall cover all parts, labor, and travel expenses.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Transfer Switches - Basis of Design: Same manufacturer as Engine Generator. Refer to 26 3213.

B. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.

2.2 TRANSFER SWITCHES

A. Provide complete power transfer system consisting of all required equipment, conduit, boxes, wiring, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.

B. Provide products listed, classified, and labeled as suitable for the purpose intended.

C. Applications:

1. Utilize open transition transfer unless otherwise indicated or required.

2. Neutral Switching (Three Phase, Four Wire Systems):

a. Unless otherwise indicated or required, provide solid (unswitched) neutral.

D. Construction Type: Either "contactor type" (open contact) or "breaker type" (enclosed contact) transfer switches complying with specified requirements are acceptable.

E. Ratings/Characteristics:

1. Transfer Switch Type: As indicated on the drawings.

2. Transition Configuration: As indicated on the drawings.

3. Voltage: As indicated on the drawings.

4. Ampere Rating: As indicated on the drawings.

5. Neutral Configuration: Solid neutral (unswitched), except as indicated.

6. Load Served: As indicated on the drawings.

7. Primary Source: As indicated on the drawings.

8. Alternate Source: As indicated on the drawings.

F. Comply with NEMA ICS 10 Part 1, and list and label as complying with UL 1008 for the classification of the intended application (e.g. emergency, optional standby).

G. Do not use double throw safety switches or other equipment not specifically designed for power transfer applications and listed as transfer switch equipment.

H. Load Classification: Classified for total system load (any combination of motor, electric discharge lamp, resistive, and tungsten lamp loads with tungsten lamp loads not exceeding 30 percent of the continuous current rating) unless otherwise indicated or required.

I. Switching Methods:

1. Open Transition:

a. Provide break-before-make transfer without a neutral position that is not connected to either source, and with interlocks to prevent simultaneous connection of the load to both sources.

2. Obtain control power for transfer operation from line side of source to which the load is to be transferred.

J. Service Conditions: Provide transfer switches suitable for continuous operation at indicated ratings under the service conditions at the installed location.

K. Enclosures:

1. Environment Type per NEMA 250: As indicated on the drawings.

2. Finish: Manufacturer's standard unless otherwise indicated.

L. Short Circuit Current Rating:

1. Withstand and Closing Rating: Provide transfer switches, when protected by the supply side overcurrent protective devices to be installed, with listed withstand and closing rating not less than the available fault current at the installed location as indicated on the drawings.

M. Automatic Transfer Switches:

1. Description: Transfer switches with automatically initiated transfer between sources; electrically operated and mechanically held.

2. Control Functions:

a. Automatic mode.

b. Test Mode: Simulates failure of primary/normal source.

c. Voltage and Frequency Sensing:

1) Undervoltage sensing for each phase of primary/normal source; adjustable dropout/pickup settings.

2) Undervoltage sensing for alternate/emergency source; adjustable dropout/pickup settings.

3) Underfrequency sensing for alternate/emergency source; adjustable dropout/pickup settings.

d. Outputs:

1) Contacts for engine start/shutdown (except where direct generator communication interface is provided).

2) Auxiliary contacts; one set(s) for each switch position.

e. Adjustable Time Delays:

1) Engine generator start time delay; delays engine start signal to override momentary primary/normal source failures.

2) Transfer to alternate/emergency source time delay.

3) Retransfer to primary/normal source time delay.

4) Engine generator cooldown time delay; delays engine shutdown following retransfer to primary/normal source to permit generator to run unloaded for cooldown period.

f. In-Phase Monitor (Open Transition Transfer Switches): Monitors phase angle difference between sources for initiating in-phase transfer.

g. Engine Exerciser: Provides programmable scheduled exercising of engine generator selectable with or without transfer to load; provides memory retention during power outage.

3. Status Indications:

a. Connected to alternate/emergency source.

b. Connected to primary/normal source.

c. Alternate/emergency source available.

4. Other Features:

a. Event log.

b. Communications Capability: Compatible with system indicated. Provide all accessories necessary for proper interface.

5. Automatic Sequence of Operations:

a. Upon failure of primary/normal source for a programmable time period (engine generator start time delay), initiate starting of engine generator where applicable.

b. When alternate/emergency source is available, transfer load to alternate/emergency source after programmable time delay.

c. When primary/normal source has been restored, retransfer to primary/normal source after a programmable time delay. Bypass time delay if alternate/emergency source fails and primary/normal source is available.

d. Where applicable, initiate shutdown of engine generator after programmable engine cooldown time delay.

6. Provide transfer switches with suitable lugs to terminate the conductors (size & quantity) specified on the Contract Drawings.

N. Interface with Other Work:

1. Interface with engine generators as specified in Section 26 3213.

a. Transfer switch and engine generator to be produced by the same manufacturers. It is the responsibility of the contractor to ensure both the engine generator and transfer switch are compatible and interface the two pieces of equipment for a complete and operable emergency generator system.

b. Demonstrate to owner the complete operation of the transfer switch and generator system.

2.3 SOURCE QUALITY CONTROL

A. Perform production tests on transfer switches at factory to verify operation and performance characteristics prior to shipment. Include certified test report with submittals.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the ratings and configurations of transfer switches are consistent with the indicated requirements.

C. Verify that rough-ins for field connections are in the proper locations.

D. Verify that mounting surfaces are ready to receive transfer switches.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Arrange equipment to provide minimum clearances and required maintenance access.

D. Provide required support and attachment in accordance with Section 26 0529.

E. transfer switches to be plumb and level.

F. Unless otherwise indicated, mount floor-mounted transfer switches on properly sized 4 inch high concrete pad.

G. Provide grounding and bonding in accordance with Section 26 0526.

H. Identify transfer switches and associated system wiring in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

A. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.

B. Prepare and start system in accordance with manufacturer's instructions.

C. Automatic Transfer Switches:

1. Inspect and test in accordance with NETA ATS, except Section 4.

2. Perform inspections and tests listed in NETA ATS, Section 7.22.3. The insulation-resistance tests listed as optional are not required.

    a. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

D. Provide additional inspection and testing as required for completion of associated engine generator testing as specified in Section 26 3213.

E. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.

F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.4 CLEANING

A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.5 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of transfer switches to Owner, and correct deficiencies or make adjustments as directed.

B. Training: Train Owner's personnel on operation, adjustment, and maintenance of transfer switches.

1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.

2. Provide minimum of four hours of training.

3. Instructor: Manufacturer's authorized representative.

4. Location: At project site.

C. Coordinate with related generator demonstration and training as specified in Section 26 3213.

3.6 PROTECTION

A. Protect installed transfer switches from subsequent construction operations.

END OF SECTION

SECTION 26 4113 - LIGHTNING PROTECTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Under this Section, the Contractor shall furnish all labor, materials and equipment as necessary to provide an adequate Lightning Protection System, as specified for the following buildings/structures in accordance with NFPA. Refer to the Contract Drawings for building floor plans to obtain dimensions and roof information.

1. WWTP Site - Headworks Building (Sheet E-200)
2. WWTP Site - Primary Settling Tanks (Sheet E-300)
3. WWTP Site - ATAD Building, Drum Thickener, Sludge Holding Tank, Thermaer Reactor, SNDR Reactor, & Biofilter (Sheet E-400)
4. WWTP Site - MBR Building, Screening Building, & Aerobic Zones (Sheet E-500)
5. WWTP Site - Dechlorination Building, Tanks, & Platforms (Sheet E-600)
6. WWTP Site - Dewatering Building (Sheet E-700)
7. WWTP Site - Garage (Sheet E-950)

1.2 SECTION INCLUDES

A. Strike (air) terminals and interconnecting conductors.

B. Grounding and bonding for lightning protection.

C. All associated components/hardware.

1.3 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems: Electrical system grounds.

1.4 REFERENCE STANDARDS

A. NFPA 780 - Standard for the Installation of Lightning Protection Systems; 2020.

B. UL 96 and UL96A - Lightning Protection Components and Installation; Current Edition, Including All Revisions.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination with Concrete Work: Coordinate the embedding of lightning protection components in new concrete as required.

    1. Note, proposed structures will have down conductors in conduit within the exterior wall. Refer to the Contract Drawings for additional information.

B. Coordination with Roofing Work: Ensure adequate attachment of strike terminals and conductors without damage to roofing.

    1. Contractor to coordinate with applicable trade contractor, owner, and engineer to provide suitable air terminal bases for the new roof construction anticipated.

C. Preinstallation Meeting: Convene a meeting at least two weeks prior to commencement of any work affected by lightning protection system requirements to discuss prerequisites and coordination required by other installers; require attendance by representatives of installers whose work will be affected.

D. Closely coordinate the installation of the LPS system for the above listed buildings and structures with equipment manufacturers, owner, engineer, and applicable trade contractor. Refer to contract drawings for additional information.

1.6 SUBMITTALS

A. Shop Drawings: Indicate location and layout of air terminals, grounding electrodes, and bonding connections to structure and other metal objects. Include terminal, electrode, and conductor sizes, and connection and termination details.

    1. Where conductors or grounds are to be embedded or concealed in other construction, submit shop drawings at least 30 days prior to start of construction.

    2. If concrete-encased grounds are to be used and are not shown in Contract Documents, provide sufficient data to determine concrete encasement dimensions and location.

    3. Include data on actual ground resistance determined by field measurement in accordance with NFPA 780.

    4. Include engineering analysis of equalization of potential to metal bodies within the structure.

    5. Roof/wall penetration and mounting details.

B. Product Data: Provide dimensions and materials of each component, indication of testing agency listing, and installation instructions.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

D. Installation Certification: Submit copy of certification agency's approval.

E. Upon completion of construction submit Master UL Label. If a Master UL label is not obtainable based upon the building classification (hazardous) the contractor is to submit a UL "Letter of Findings". Letter of Findings to indicate the system has been inspected and in compliance with UL 96A.

F. Operation and Maintenance Data: Provide recommended inspection and testing plan, including recommended intervals, to achieve periodic maintenance as recommended in NFPA 780; provide customized plan reflecting actual installation configuration with specific installed components identified.

G. Project Record Documents: Record actual locations of air terminals, grounding electrodes, bonding connections, and routing of system conductors in project record documents.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in lightning protection equipment installation with minimum three years documented experience.

B. Designer Qualifications: Person or entity, employed by installer, who specializes in lightning protection system design with minimum three years documented experience and certified by the LPI (Lightning Protection Institute) as a Master Installer / Designer.

C. Installer Qualifications: Capable of providing the specified certification of the installed system and certified by the LPI as a Journeyman Lightning Protection Installer.

D. Products: Must be UL listed for lightning protection systems.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Lightning Protection Components:

1. VFC: https://vfclp.com/

2. Independent Protection Company: www.ipclp.com

3. Advanced Lightning Technology (ALT): www.altfab.com.

4. Harger Lightning and Grounding: www.harger.com.

5. National Lightning Protection Corporation: www.theprotectionsource.com.

6. Robbins Lightning Incorporated: www.robbinslightning.com

B. The system to be furnished under this Specification shall be the standard product of a manufacturer regularly engaged in the production of lightning protection systems and shall be the manufacturer's latest approved design. The equipment manufacturer shall also be an UL listed and approved manufacturer and a fully certified manufacturer member in good standing of the Lightning Protection Institute.

C. Lightning Protection Installer:

1. TEL Inc. (www.tel-lightning.com).
2. Crowley Lightning Protection, Inc.
3. Morse-Collins, Inc.(www.morse-collins.com)
4. VFC: https://vfclp.com/
5. Robbins Lightning Incorporated: www.robbinslightning.com

2.2 LIGHTNING PROTECTION SYSTEM

A. Lightning Protection System: Provide complete system complying with NFPA 780, including air terminals, bonding, interconnecting conductors and grounding electrodes.

1. Provide system that protects:

a. The entire structure (refer to article 1.01 A above for the proposed buildings/structures which are to be provided with a lightning protection system as part of this contract).

b. Open air areas within building/structure footprint.

c. Metal fences identified on site plan.

d. Aboveground tanks.

2. Coordinate with other grounding and bonding systems specified.
3. Determine ground resistance by field measurement.
4. Provide copper, bronze, or stainless steel components, except where aluminum is allowed by NFPA 780.
5. Provide system certified by Underwriters Laboratories. Refer to article 1.06 (E) above for additional information.

B. Strike Terminals: Provide strike (air) terminals on the following:

1. Roofs (buildings).

2. Roof mounted equipment.

3. Aluminum handrail encircling basin/tank structures.

2.3 COMPONENTS

A. All Components: Complying with applicable requirements of UL 96.

B. Strike (Air) Terminals: Copper, solid, where applicable and allowed by standard. Use aluminum where required to prevent galvanic corrosion.

1. Provide size as required by building classification.

C. Grounding Rods: Copper Clad

D. Ground Plate: Copper.

E. Conductors: Copper cable where applicable and allowed by standard. Use aluminum where required to prevent galvanic corrosion.

F. Connectors and Splicers: Bronze / cast aluminum.

G. Through Roof Connectors: Stainless/Bronze. Coordinate with owner, engineer, and applicable trade contractor closely as required.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated on shop drawings.

B. Coordinate work with installation of roofing and exterior and interior finishes.

3.2 INSTALLATION

A. Install in accordance with referenced system standards and as required for specified certification.

B. Submit UL master label upon completion of construction. Refer to article 1.06 (E) above for additional information.

C. Connect conductors using mechanical connectors or exothermic welding process; protect adjacent construction elements and finishes from damage.

D. Main down conductors to be installed within the new wall construction within protective PVC conduit. Where lightning protection system is to be provided for existing buildings/structures the main down conductor is to be installed within conduit along the building exterior wall. Refer to the Contract Drawings for additional information.

E. Each down conductor to be tied to a single copper 3/4" x 10'-0" ground rod driven 12" under grade and at least 2'-0" away from the building edge. Down conductor connection to the ground rod to be mechanical or exothermic. Final requirements to be per UL requirements.

F. All connections to the roofing system to be watertight.

G. Provide necessary bonds where required to bond the lightning protection system to the electric, gas, and water systems.

3.3 FIELD QUALITY CONTROL

A. Perform visual inspection as specified in NFPA 780 as if this were a periodic follow-up inspection.

B. Perform continuity testing as specified in NFPA 780 as if this were testing for periodic maintenance.

C. Obtain the services of the specified certification agency to provide inspection and certification of the lightning protection system, including performance of any other testing required by that agency.

END OF SECTION

SECTION 26 4300 - SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Surge protective devices for branch panelboard, switchboard, and motor control center locations.

1.2 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 2413 - Switchboards.

C. Section 26 2416 - Panelboards.

D. Section 26 2419 - Motor-Control Centers.

1.3 ABBREVIATIONS AND ACRONYMS

A. SPD: Surge Protective Device.

B. TVSS: Transient Voltage Surge Supression

1.4 REFERENCE STANDARDS

A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.

C. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

E. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate size and location of overcurrent device compatible with the actual surge protective device and location to be installed. Notify Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to ordering equipment.

1.6 SUBMITTALS

A. Product Data: Include detailed component information, voltage, surge current ratings, repetitive surge current capacity, voltage protection rating (VPR) for all protection modes, maximum continuous operating voltage (MCOV), nominal discharge current (I-n), short circuit current rating (SCCR), connection means including any required external overcurrent protection, enclosure ratings, outline and support point dimensions, weight, service condition requirements, and installed features.

B. Shop Drawings: Include wiring diagrams showing all factory and field connections with wire and circuit breaker/fuse sizes.

C. Certificates: Manufacturer's documentation of listing for compliance with the following standards:

1. UL 1449.

D. Field Quality Control Test Reports.

E. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

F. Operation and Maintenance Data: Include information on status indicators and recommended maintenance procedures and intervals.

G. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

H. Project Record Documents: Record actual connections and locations of surge protective devices.

1.7 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.8 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in accordance with manufacturer's written instructions.

1.9 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.10 WARRANTY

A. Manufacturer's Warranty: Provide minimum five year warranty covering repair or replacement of surge protective devices showing evidence of failure due to defective materials or workmanship.

B. Exclude surge protective devices from any clause limiting warranty responsibility for acts of nature, including lightning, stated elsewhere.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Factory-installed, Internally Mounted Surge Protective Devices:

1. Same as manufacturer of equipment containing surge protective device, to provide complete listed assembly including SPD.

2.2 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS

A. Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated on the drawings.

B. Unless otherwise indicated, provide field-installed, externally-mounted or factory-installed, internally-mouonted SPDs.

C. List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.

D. Protected Modes:

1. Wye Systems: L-N, L-G, N-G, L-L.

E. UL 1449 Voltage Protection Ratings (VPRs):

1. Equivalent to basis of design.

2. 208Y/120V System Voltage: Not more than 1,000 V for L-N, L-G, and N-G modes and 1,200 V for L-L mode.

3. 480Y/277V System Voltage: Not more than 1,500 V for L-N, L-G, and N-G modes and 2,000 V for L-L mode.

F. UL 1449 Maximum Continuous Operating Voltage (MCOV): Not less than 115% of nominal system voltage.

G. Enclosure Environment Type per NEMA 250: As indicated on the drawings.

H. Equipment Containing Factory-installed, Internally Mounted SPDs: Listed and labeled as a complete assembly including SPD.

1. Switchboards: See Section 26 2413.

2. Panelboards: See Section 26 2416.

3. Motor Control Centers: See Section 26 2419.

2.3 SURGE PROTECTIVE DEVICES FOR BRANCH PANELBOARD, SWITCHBOARD, AND MOTOR CONTROL CENTER LOCATIONS

A. Unless otherwise indicated, provide factory-installed, internally mounted SPDs.

B. Surge Current Rating: Not less than 80 kA per mode/160 kA per phase.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that the service voltage and configuration marked on the SPD are consistent with the service voltage and configuration at the location to be installed.

C. Verify that electrical equipment is ready to accept connection of the SPD and that installed overcurrent device is consistent with requirements of drawings and manufacturer's instructions.

D. Verify system grounding and bonding is in accordance with Section 26 0526, including bonding of neutral and ground for service entrance and separately derived systems where applicable. Do not energize SPD until deficiencies have been corrected.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

A. Perform work in accordance with NECA 1 (general workmanship).

B. Install products in accordance with manufacturer's instructions.

C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

D. Unless indicated otherwise, connect service entrance surge protective device on load side of service disconnect main overcurrent device.

E. Provide conductors with minimum ampacity as indicated on the drawings, as required by NFPA 70, and not less than manufacturer's recommended minimum conductor size.

F. Install conductors between SPD and equipment terminations as short and straight as possible, not exceeding manufacturer's recommended maximum conductor length. Breaker locations may be reasonably rearranged in order to provide leads as short and straight as possible. Twist conductors together to reduce inductance.

G. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 26 0526 where applicable. Replace SPDs damaged by improper or missing neutral-ground bond.

H. Disconnect SPD prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPD connected.

3.3 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS Section 7.19.1.

C. Procure services of a qualified manufacturer's representative to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's reports with field quality control submittals.

3.4 CLEANING

A. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 5100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Interior luminaires.

B. Emergency lighting units.

C. Exit signs.

D. Drivers.

1.2 RELATED REQUIREMENTS

A. Section 26 0529 - Hangers and Supports for Electrical Systems.

B. Section 26 0537 - Boxes.

C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

D. Section 26 0922 - Lighting Control Devices: Automatic controls for lighting including occupancy sensors, time switches, and outdoor photo controls.

E. Section 26 2726 - Wiring Devices: Manual wall switches.

F. Section 26 5600 - Exterior Lighting.

1.3 REFERENCE STANDARDS

A. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; 2008.

B. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; Illuminating Engineering Society; 2015.

C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

D. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; 2006.

E. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.

F. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2012.

G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

H. NFPA 101 - Life Safety Code; 2015.

I. UL 844 - Luminaires for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.

J. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.

K. UL 1598 - Luminaires; Current Edition, Including All Revisions.

L. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.

2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.

3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.

4. Notify Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.5 SUBMITTALS

A. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.

1. LED Luminaires:

a. Include estimated useful life, calculated based on IES LM-80 test data.

B. Certificates for Dimming Drivers: Manufacturer's documentation of compatibility with dimming controls to be installed.

C. Field quality control reports.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

E. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. Extra Lenses: Two percent of total quantity installed for each type, but not less than two of each type where used.

2. Extra Drivers: Two percent of total quantity installed for each type, but not less than two of each type where used.

G. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND PROTECTION

A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.8 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

B. Where Contract Drawings call out a classified area all equipment, devices, and wiring methods to be suitable for this area per NEC. Refer to Contract Drawings for classified area locations and section 26 2727 for additional information.

1.9 WARRANTY

A. Provide 3-year manufacturer warranty for LED luminaires, including drivers.

B. Provide 5-year pro-rata warranty for batteries for emergency lighting units.

C. Provide 10-year pro-rata warranty for batteries for self-powered exit signs.

PART 2 - PRODUCTS

2.1 MANUFACTURERS - LUMINAIRES

A. Cooper Lighting, a division of Cooper Industries or approved equal. : www.cooperindustries.com.

2.2 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings or approved equal.

2.3 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.

B. Provide products that are listed and labeled as complying with UL 1598, where applicable.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Unless otherwise indicated, provide complete luminaires including all drivers, reflectors, lenses, housings and other components required to position, energize, protect and distribute the light.

E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.

F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

G. Recessed Luminaires:

1. Ceiling Compatibility: Comply with NEMA LE 4.

2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.

3. Luminaires Recessed in Sloped Ceilings: Provide suitable sloped ceiling adapters.

H. Hazardous (Classified) Location Luminaires: Listed and labeled as complying with UL 844 for the classification of the installed location.

I. LED Luminaires:

1. Components: UL 8750 recognized or listed as applicable.

2. Tested in accordance with IES LM-79 and IES LM-80.

3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

2.4 EMERGENCY LIGHTING UNITS

A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.

B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.

C. Battery:

1. Size battery to supply all connected lamps, including emergency remote heads where indicated.

D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.

E. Provide low-voltage disconnect to prevent battery damage from deep discharge.

F. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status.

G. Where indicated, provide units with integral time delay to maintain emergency illumination for 15 minutes after restoration of normal power source.

H. Accessories:

1. Provide compatible accessory mounting brackets where indicated or required to complete installation.

2. Where indicated, provide emergency remote heads that are compatible with the emergency lighting unit they are connected to and suitable for the installed location.

2.5 EXIT SIGNS

A. Description: Exit signs complying with NFPA 101 and applicable state and local codes, and listed and labeled as complying with UL 924.

1. Number of Faces: Single- or double-face as indicated or as required for installed location.

2. Directional Arrows: As indicated or as required for installed location.

B. Powered Exit Signs: Internally illuminated with LEDs unless otherwise indicated.

1. Self-Powered Exit Signs:

a. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.

b. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.

c. Provide low-voltage disconnect to prevent battery damage from deep discharge.

2.6 **DRIVERS**

A. Dimmable LED Drivers:

1. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.

2. Control Compatibility: Fully compatible with the dimming controls to be installed.

2.7 ACCESSORIES

A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.

B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted as directed.

C. Provide accessory plaster frames for luminaires recessed in plaster ceilings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

C. Verify that suitable support frames are installed where required.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of luminaires provided under this section.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install products in accordance with manufacturer's instructions.

D. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).

E. Provide required support and attachment in accordance with Section 26 0529.

F. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

G. Install luminaires in locations as shown on the contract drawings or as close as possible to the locations shown with minor adjustments as required to avoid interferances.

H. Suspended Ceiling Mounted Luminaires:

1. Do not use ceiling tiles to bear weight of luminaires.

2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.

3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.

4. Secure pendant-mounted luminaires to building structure.

5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.

6. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gauge, connected from opposing corners of each recessed luminaire to building structure.

I. Recessed Luminaires:

1. Install trims tight to mounting surface with no visible light leakage.

2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.

3. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.

J. Suspended Luminaires:

1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.

2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.

3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet nominal length, with no more than 4 feet between supports.

K. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.

L. Install accessories furnished with each luminaire.

M. Bond products and metal accessories to branch circuit equipment grounding conductor.

N. Emergency Lighting Units:

1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.

O. Exit Signs:

1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.

P. Identify luminaires connected to emergency power system in accordance with Section 26 0553.

3.4 FIELD QUALITY CONTROL

A. Inspect each product for damage and defects.

B. Operate each luminaire after installation and connection to verify proper operation.

C. Test self-powered exit signs and emergency lighting units to verify proper operation upon loss of normal power supply.

D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy drivers as determined by Engineer.

3.5 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Engineer. Secure locking fittings in place.

B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Engineer or authority having jurisdiction.

C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Engineer or authority having jurisdiction.

3.6 CLEANING

A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.7 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of luminaires to Engineer, and correct deficiencies or make adjustments as directed.

B. Just prior to Substantial Completion, clean luminaires.

3.8 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

SECTION 26 5600 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Exterior luminaires.

B. Poles.

1.2 RELATED REQUIREMENTS

A. Section 26 0526 - Grounding and Bonding for Electrical Systems.

B. Section 26 0529 - Hangers and Supports for Electrical Systems.

C. Section 26 0537 - Boxes.

D. Section 26 0922 - Lighting Control Devices: Automatic controls for lighting including time switches and outdoor photo controls.

E. Section 26 2726 - Wiring Devices.

F. Section 26 5100 - Interior Lighting.

1.3 REFERENCE STANDARDS

A. IEEE C2 - National Electrical Safety Code; 2012.

B. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; 2008.

C. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; Illuminating Engineering Society; 2015.

D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.

E. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems; 2006.

F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

G. UL 1598 - Luminaires; Current Edition, Including All Revisions.

H. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under other sections or by others. Coordinate elevation to obtain specified foundation height.

2. Notify Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.5 SUBMITTALS

A. Shop Drawings:

1. Indicate dimensions and components for each luminaire.

2. Provide photometric calculations.

3. Provide structural calculations for each pole.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.

1. LED Luminaires:

a. Include estimated useful life, calculated based on IES LM-80 test data.

2. Poles: Include information on maximum supported effective projected area (EPA) and weight for the design wind speed.

C. Certificates for Poles and Accessories: Manufacturer's documentation that products are suitable for the luminaires to be installed and comply with designated structural design criteria.

D. Field Quality Control Reports.

1. Include test report indicating measured illumination levels.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

F. Operation and Maintenance Data: Instructions for each product including information on replacement parts.

G. Project Record Documents: Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.

1.6 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.

B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.8 WARRANTY

A. Provide 2-year manufacturer warranty for all LED luminaires, including drivers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Cooper Lighting, a division of Cooper Industries or approved equal. : www.cooperindustries.com.

1. Refer to schedules on the Contract Drawings for additional basis of design info.

2.2 LUMINAIRE TYPES

A. Furnish products as indicated in luminaire schedule included on the drawings or approved equal.

2.3 LUMINAIRES

A. Provide products that comply with requirements of NFPA 70.

B. Provide products that are listed and labeled as complying with UL 1598, where applicable.

C. Provide products listed, classified, and labeled as suitable for the purpose intended.

D. Unless otherwise indicated, provide complete luminaires including all reflectors, lenses, housings and other components required to position, energize, protect, and distribute the light.

E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.

F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

G. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.

H. LED Luminaires:

1. Components: UL 8750 recognized or listed as applicable.

2. Tested in accordance with IES LM-79 and IES LM-80.

3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

I. Exposed Hardware: Stainless steel.

2.4 POLES

A. Manufacturers:

1. Cooper Lighting, a division of Cooper Industries: www.cooperindustries.com. or approved equal.

B. All Poles:

1. Provide poles and associated support components suitable for the luminaire(s) and associated supports and accessories to be installed.

C. Metal Poles: Provide ground lug, accessible from handhole.

D. Refer to Contract Drawings for additional information.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.

C. Verify that suitable support frames are installed where required.

D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.

E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

A. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of luminaires provided under this section.

B. Perform work in accordance with NECA 1 (general workmanship).

C. Install products in accordance with manufacturer's instructions.

D. Install luminaires in accordance with NECA/IESNA 501.

E. Provide required support and attachment in accordance with Section 26 0529.

F. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.

G. Install luminaires in locations as shown on the contract drawings or as close as possible to the locations shown when necessary to make minor modifications to avoid interferances.

H. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.

I. Pole-Mounted Luminaires:

1. Maintain the following minimum clearances:

a. Comply with IEEE C2.

b. Comply with utility company requirements.

2. Foundation-Mounted Poles:

   a. Provide cast-in-place concrete foundations for poles as indicated on the Contract Drawings.

   b. Install anchor bolts plumb per template furnished by pole manufacturer

   c. Position conduits to enter pole shaft

   d. Install foundations plumb.

   e. Install poles plumb, using leveling nuts or shims as required to adjust to plumb.

   f. Tighten anchor bolt nuts to manufacturer's recommended torque.

3. Grounding:

   a. Bond luminaires, metal accessories, metal poles, and foundation reinforcement to branch circuit equipment grounding conductor.

   b. Provide supplementary ground rod electrode as specified in Section 26 0526 at each pole bonded to grounding system as indicated.

4. Install separate service conductors, 12 AWG copper, from each luminaire down to handhole for connection to branch circuit conductors.

5. Install weather resistant GFI duplex receptacle with weatherproof cover as specified in Section 26 2726 at each pole.

J. Install accessories furnished with each luminaire.

3.4 FIELD QUALITY CONTROL

A. Inspect each product for damage and defects.

B. Operate each luminaire after installation and connection to verify proper operation.

C. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy drivers as determined by Engineer.

D. Measure illumination levels at night with calibrated meters to verify compliance with performance requirements. Record test results in written report to be included with submittals.

3.5 ADJUSTING

A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Engineer. Secure locking fittings in place.

B. Luminaires with Field-Rotatable Optics: Position optics according to manufacturer's instructions to achieve lighting distribution as indicated or as directed by Engineer.

3.6 CLEANING

A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.7 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate proper operation of luminaires to Engineer, and correct deficiencies or make adjustments as directed.

B. Just prior to Substantial Completion, clean luminaires.

3.8 PROTECTION

A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

SECTION 310000 - EARTHWORK

PART 1 - GENERAL

1.1 EARTHWORK:

A. Earthwork required for this work includes, but is not necessarily limited to filling and backfilling to attain indicated grades.

1.2 RELATED WORK DESCRIBED ELSEWHERE:

A. Clearing and Grubbing - Section 311100

B. Erosion and Sediment Control – Section 312500

C. Dewatering – Section 312319

D. Rock Excavation – Section 312316

1.3 QUALITY ASSURANCE:

A. Notify Engineer 48 hours in advance of any backfill of existing or new work including all underground utilities.

1.4 SUBMITTALS:

A. Submit testing laboratory reports on imported fill within 10 days after receipt of same from the testing laboratory.

1.5 REFERENCE STANDARDS:

A. The following test standards apply to the work under this section:

1. ASTM D2216, “Laboratory Determination of Moisture Content of Soil.”
2. ASTM D422, “Particle-Size Analysis of Soils.”
3. ASTM D698, “Test method for Laboratory Compaction Characteristics of Soil Using Standard Effort.(Standard Proctor)
4. ASTM D1557, “Test method for Laboratory Compaction Characteristics of Soil Using Modified Effort.(Modified Proctor)
5. ASTM D2922, “Density of Soil and Soil Aggregate in Place by nuclear Methods.”
6. ASTM D2937, “Density of Soil in Place by the Drive-Cylinder Method.”
7. ASTM D3107, “Test for Moisture Content of Soil and Soil Aggregate in Place by Nuclear Methods.”

PART 2 - PRODUCTS

2.1 FILL MATERIALS, GENERAL:

A. Fill and backfill material shall be subject to acceptance of the Engineer from site excavation or from offsite borrow.

2.2 ON-SITE BACKFILL MATERIALS:

A. All on-site materials shall be soil or soil/rock mixture which is free from organic matter and other deleterious substances; it shall contain no rocks or lumps over six inches in greatest dimension, and not more than 15% of the rocks or lumps shall be larger than 2-1/2 inches in greatest dimension.

2.3 IMPORTED BACKFILL MATERIALS:

A. All imported backfill materials shall meet with requirements of Article 2.2 above.

2.4 GRANULAR CUSHION:

A. Granular cushion under all concrete slabs shall be crushed non-porous rock or uncrushed gravel complying with ASTM C33 Gradation Size No. 67, ¾" into No. 4.

2.5 OTHER MATERIALS:

A. All other materials, not specifically described but required for a complete and proper installation of work described in this Section, shall be as selected by the Contractor, subject to the acceptance of the Engineer.

PART 3 - EXECUTION

3.1 COORDINATION:

A. Contractor shall coordinate all excavation work to be performed to avoid duplication of effort and to make maximum use of an open excavation by all trades.

B. At least 72 hours prior to excavating, Contractor shall contact the Owner's Representative at the beginning of each phase to arrange for utility locates in the construction area.

C. Time spent by Owner to identify utilities and status of utilities discovered during excavation and not shown on the Drawings shall not be the basis of a change order request from the Contractor.

3.2 PREPARATION:

A. Protection structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards create by earthwork.

B. Preparation of subgrade for earthwork operations including removal of topsoil, debris, obstructions, and deleterious materials from ground surface.

C. Protect and maintain erosion and sedimentation controls, which are specified in Section 312500 “Erosion and Sediment Control” during earthwork operations.

D. Provide protective insulating materials to protect subgrades and foundation soils against freezing temperatures or frost.

3.3 ROCK EXCAVATION:

A. Rock excavation includes excavation, removal and disposal of materials and obstructions encountered which, in the opinion of the Engineer, cannot be excavated except by drilling and blasting or by drilling and wedging. Typical of materials classified as rock are boulders 1.0 cubic yard or more in volume, solid rock, rock in ledges, and rock-hard cementitious aggregate deposits.

B. Intermittent drilling, blasting or ripping, performed to increase production and not necessary to permit excavation of material encountered, will not be classified as earth excavation.

C. Payment limits for rock excavation shall be limited to a maximum of one-foot (1 foot) horizontally outside the limits of the structure or pipe to be installed, and a maximum of six inches below the bottom of the pipe, conduit or structure to be installed in the excavation.

D. Rock excavation shall be paid for at the unit price per cubic yard bid in the proposal and only for those quantities verified by the Engineer in the field prior to backfill. It is understood that the price per cubic yard bid for rock excavation includes drilling, blasting, excavation, splitting, removal, disposal of all rock and the furnishing and installation of suitable granular foundation material to properly support the pipe, conduit or structure to be installed in the excavation.

3.4 FILL AND COMPACTION:

A. Backfill and new fill shall be placed in layers not exceeding 6 inches in depth, approximately parallel to the plain of the floor or concourse. Fill material shall be thoroughly compacted to 95% minimum density at optimum moisture content, as determined by the Laboratory Method of Test for Moisture-Density Relations of Soil. Using a 5.5 lb. rammer and 12 inch drop (ASTM D698). Filling shall be done as soon as possible, but not when ground is frozen or covered with ice or snow. This fill is to be allowed to set a sufficient time before concrete is placed. Where soil is backfilled, inside the building against exterior walls or areas not accessible to mechanical rollers, these areas shall be tamped by pneumatic hand tamping or equal; to give the same compaction as specified.

3.5 BACKFILLING PRIOR TO ACCEPTANCE:

A. Do not allow or cause any of the Work performed or installed to be covered up or enclosed by work of this Section, prior to all required inspections, tests and acceptance. Should any of the work be so enclosed or covered up before it has been accepted, uncover all such work at no additional cost to the Owner. After the work has been completely tested, inspected and accepted, make all repairs and replacements necessary to restore the work to the condition in which it was found at the time of uncovering, all at no additional cost to the Owner.

3.6 DEBRIS:

A. No existing new debris will be used as fill material or be buried on site. Contractor will remove debris from site to a dumping facility approved by local, County, and State authorities.

3.7 OVER-EXCAVATION:

A. Backfill all overexcavated areas with concrete or as specified for fill (3.7) at no additional cost to the owner.

3.8 GRADING:

A. Except as otherwise directed by the Engineer, perform all rough and finish grading required to attain the elevations indicated on the drawings. After grading is completed and the Engineer has finished his review, permit no further excavation, filling or grading except with the acceptance and the review of the Engineer. Provide and place, at no additional cost to the Owner, any additional fill material from off-site, as may be necessary to produce sub-grades required or indicated. If excess fill exists, Contractor may remove and keep same, with the Engineer's acceptance and at no cost to the Owner.

3.9 TRENCHING:

A. Perform all trenching required for the installation of the items where the trenching is not specifically described in other Sections of these Specifications. Make all trenches open vertical construction with sufficient width to provide free working space at both sides of the trench and around the installed items as required for caulking, joining, backfilling and compacting. Provide any required shoring and bracing.

3.10 FOUNDATION FOR PIPES:

A. Grade the trench bottoms to provide a smooth, firm and stable foundation free of rock points throughout the length of the pipe. Place a minimum of six inches of the specified cohesionless material in the bottom of the trench.

3.11 BACKFILL FOR PIPES:

A. After the pipe has been laid, true to line and grade, thoroughly bedded and covered, spread the on-site material in uniform lifts of not more than six inches in uncompacted thickness, and then compact as specified in this Section. Repeat the spreading and compacting procedure until adjacent grade level is attained.

3.12 CLEAN-UP AND REMOVALS:

A. Contractor shall, at all times, keep the premises and/or site free from accumulations of waste materials, rubbish, superfluous earth, rock and dirt caused by the excavations, employees or construction of the building. At the completion of the work, Contractor shall remove all his rubbish and his tools from and about the building or premises.

3.13 SHORING AND BRACING:

A. It shall be the sole responsibility of the Contractor to properly brace and shore all excavations. The Contractor shall be solely responsible to comply with all applicable codes, rules, laws, regulations, etc. of any and all agencies having jurisdiction over the proper shoring and bracing of excavations. The Owner, Engineer and Architect shall in no way be responsible for the Contractor's failure to comply or compliance with any regulation dealing with shoring and/or bracing of excavations, and will assume no responsibility for the maintenance or creation of a properly shored and braced excavation. There shall be no extra cost to the Owner for shoring and/or bracing.

3.14 QUALITY CONTROL: SUPERVISION, INSPECTION, AND RECORDS

A. The Contractor shall retain an Independent Testing Agency to perform fill sampling and testing. The work performed by the testing agency shall be supervised by a registered geotechnical engineer.

B. Test material gradation for all fill materials in accordance with ASTM 422. Sample and test a minimum of one test per every 5,000 cubic yards placed.

C. Perform compaction testing of each lift of the embankment fill and final grading in accordance with ASTM D 1556 or ASTM D 6938. Perform at least one test for every 5,000 ft^2 of surface area. Report failing tests immediately to the Engineer.

D. A complete tabulation of all test results shall be certified by the independent Testing Agency and shall be delivered to the Engineer.

END OF SECTION 310000

SECTION 311100 - CLEARING AND GRUBBING

PART 1 - GENERAL

A. WORK INCLUDED:

B. All necessary clearing and grubbing of all trees, brush, stumps, fences, debris, miscellaneous materials and miscellaneous structures not covered under other Contract Items within the construction area.

C. Clear and grub such additional areas within the limits of the right-of-way and easement lines, or other such areas specifically noted or specified.

D. Stripping of topsoil from construction areas and all areas to be excavated or filled with material to be stockpiled as directed by the Owner and/or acceptable to the Engineer.

E. Removal and proper disposal of all materials noted herein and/or encountered during the work.

1.2 RELATED WORK:

A. Erosion and Sediment Control – Section 312500

B. Rough Grading – Section 312213

1.3 EXISTING CONDITIONS:

A. The locations of existing underground utilities are shown in an approximate way only. The Contractor shall determine the exact location of all existing utilities before commencing the work.

B. The Contractor shall contact the Underground Utilities Call Center and/or utilities individually as necessary for proper notification.

C. The Contractor agrees to be fully responsible for any and all damage, which might be occasioned by his failure to exactly locate and preserve any and all underground utilities.

D. It shall be the Contractor's responsibility to investigate all site conditions that may affect his work.

PART 2 - MATERIALS

2.1 All materials utilized for related work shall comply with the requirements of the individual specification sections.

PART 3 - CONSTRUCTION DETAILS

3.1 LIMIT OF WORK AREAS:

A. The Engineer will establish the limits of areas to be cleared and grubbed, to be cleared but not grubbed, or areas, objects or features that are designated to remain undisturbed.

B. In general, work areas shall include the road section, stream channels, ditches, detours, and other areas shown on the plans or as specified.

C. The Engineer will designate fences, structures, debris, trees, and brush to be cleared where grubbing is not required.

D. Clearing beyond the areas of construction shall be done only where specified.

3.2 CLEARING AND GRUBBING:

A. On or adjacent to Roadways - all trees felled or trimmed to be immediately removed so as not to present any hazard to traffic. Grubbed stumps to be moved at least 30 feet from edge of pavement.

B. Embankments - grubbing will be required beneath all embankments unless otherwise specified by the Engineer.

C. Where trees or existing stumps are cleared and grubbing is not required, the tree trunk or existing stump shall be cut off not more than six (6) inches above the original ground surface, unless otherwise accepted. Exposed stumps not required to be removed but which are within 30' of the edge of the pavement shall be chipped out to a depth of not less than six (6) inches below the finished grade and the holes backfilled as accepted by the Engineer. This work shall be completed within one (1) week after start of work on the tree.

3.3 STRIPPING:

A. Strip any topsoil from Contractor areas and all areas to be excavated or filled.

B. Prevent mixing of topsoil with subsoil.

C. Stockpile topsoil on-site in an area acceptable to the Owner and the Engineer.

D. Prevent brush, trash, large stones and other objectionable material from being placed with stockpiled topsoil.

E. Protect stockpiled topsoil during construction operations.

F. Remove remaining topsoil from the site after completion of all restoration work and when authorized by the Owner and/or Engineer.

3.4 DISPOSAL (GENERAL):

A. No burning will be permitted on or off the contract site. All material generated by any activity for the development, modification and construction of any transportation facility shall not be burned. This shall include but not be limited to land clearing material and demolition material. Such material shall hereinafter be referred to as disposable material.

B. All wood, including grubbed stumps, shall be removed from the contract site and shall be the responsibility of the Contractor.

3.5 DISPOSAL (METHODS):

A. Disposal (no burning). All wood and brush shall be disposed of within fifteen (15) days after cutting or felling, unless otherwise accepted in writing by the Engineer and the property owner. No burning of land clearing materials that results from clearing and grubbing operations will be permitted. The Contractor will have the following options or combination of options for disposal of this material.

1. The Contractor may bury the disposable material in conformance with all local and State laws, rules or regulations off the right-of-way in locations obtained by him at his own expense. If the disposal is not in conformance with local and State requirements, the Contractor shall bear the expense for any and all required corrections, remediation, etc.
2. The Contractor may reduce all woody materials to chips and dispose the chips in compliance with paragraph B of this subsection.

B. Chipping. Wood may be reduced to chips by the use of a chipping machine or stump grinder. The chips shall be 1/2 inch maximum thickness or of other acceptable thicknesses. Chips resulting therefrom may be disposed of by being stockpiled and used as mulch for planting, in the right-of-way as accepted by the property owner, or by disposal at a location obtained at the Contractor's expense off the contract site.

C. Burying. No tree trunks, stumps, chips or other debris shall be buried at the work site. Disposal areas off site shall be acquired by the Contractor at his own expense.

PART 4 – MEASUREMENT AND PAYMENT

4.1 PAYMENT:

A. Easement Areas or Right-of-Ways: Clearing and grubbing in easement areas or right-of-ways shall be included in the unit price bid under the payment items to be installed, constructed, etc., in the easement area or right-of-ways, and no separate payment will be made.

B. All Other Areas: Clearing and grubbing shall be included in the lump sum price bid under the "Clearing and Grubbing" item. If no such item for payment is provided within the proposal, the costs for the necessary clearing and grubbing shall be deemed included in the other prices bid in the proposal, and no separate payment for this work shall be made.

END OF F:\2018\18-732 Caesar Lane WWTP Improvements\Expansion Phase\SPECS\Division 31 -

SECTION 312213 - ROUGH GRADING (NY)

PART 1 – GENERAL

1.1 WORK INCLUDED:

A. Excavate and fill for roadways/walkways, parking areas, landscaped areas and areas of improvement or other work as shown on the Drawings to subgrade elevations (or final elevations, if applicable).

B. Compaction of subgrades for all roadways, walkways or other improvements.

C. Furnish and install additional subsoil, if required to complete the work.

D. Dewater excavations as required.

E. Protect and maintain the work site.

F. Proper disposal of all excess or waste materials, and any objectionable materials encountered.

1.2 RELATED WORK:

A. Dewatering – Section 312319

B. Clearing and Grubbing - Section 311100

C. Erosion and Sediment Control – Section 312500

D. Rock Removal - Section 312316

E. Trenching, Backfilling and Compacting - Section 312333

F. Finish Grading - Section 312219

1.3 EXISTING CONDITIONS:

A. The locations of existing underground utilities are shown in an approximate way only. The Contractor shall determine the exact location of all existing utilities before commencing work.

B. The Contractor agrees to be fully responsible for any and all damage, which might be occasioned by his failure to exactly locate and preserve any and all underground utilities.

1.4 REFERENCE STANDARDS:

A. The latest edition of the following standards, as referenced herein, shall be applicable.

B. "Standard Specifications, Construction and Materials, New York State Department of

Transportation, Office of Engineering".

C. "Standard Specifications for Highway Materials and Methods of Sampling and Testing, American Association of State Highway and Transportation Officials (AASHTO)".

D. Requirements of Regulatory Agencies: Contractor shall comply with the requirements for soil erosion and sedimentation control and other requirements of governmental authorities having jurisdiction, including the State of New York.

E. The following test standards apply to the work under this section:

1. ASTM D2216, “Laboratory Determination of Moisture Content of Soil.”
2. ASTM D422, “Particle-Size Analysis of Soils.”
3. ASTM D698, “Test method for Laboratory Compaction Characteristics of Soil Using Standard Effort.(Standard Proctor)
4. ASTM D1557, “Test method for Laboratory Compaction Characteristics of Soil Using Modified Effort.(Modified Proctor)
5. ASTM D2922, “Density of Soil and Soil Aggregate in Place by nuclear Methods.”
6. ASTM D2937, “Density of Soil in Place by the Drive-Cylinder Method.”
7. ASTM D3107, “Test for Moisture Content of Soil and Soil Aggregate in Place by Nuclear Methods.”

1.5 TESTING AGENCY:

A. Contractor shall provide and pay for all costs in connection with an approved independent testing facility to determine conformance of soils and aggregate with the specifications.

1.6 SUBMITTALS REQUIRED:

A. Samples: The Contractor shall furnish earth materials to the testing laboratory for their analysis and report, as directed by the Engineer.

B. Test Results: The testing laboratory shall submit written reports of all tests, investigations, findings and recommendations to the Contractor and the Engineer. The cost for the testing shall be borne by the Contractor.

1.7 PROJECT REQUIREMENTS:

A. Notify the Engineer of any unexpected subsurface conditions.

B. Existing Utilities: Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations. Comply with OSHA requirements.

C. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult utility owner immediately for directions.

D. Cooperate with the Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner; at no cost to the Owner.

E. Do not interrupt existing utilities serving facilities occupied and used by the Owner or others, during occupied hours, except when permitted in writing by the Owner and then only after acceptable temporary utility services have been provided.

F. Provide a minimum of 48-hour notice to the Owner and receive written notice to proceed before interrupting any utility.

G. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shutoff of services if lines are active.

1.8 USE OF EXPLOSIVES:

A. Do not bring explosives onto site or use in work without prior written permission from authorities having jurisdiction. Contractor is solely responsible for handling, storage, and use of explosive materials when their use is permitted.

1.9 PROTECTION OF PERSONS AND PROPERTY:

A. Barricade open excavations occurring as part of this work and post with adequate warning lights.

B. Operate warning lights as recommended by authorities having jurisdiction.

C. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

D. Perform excavation within drip-line of large trees to remain by hand, and protect the root system from damage or dry out to the greatest extent possible. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1" diameter and larger with emulsified asphalt tree paint.

1.10 EXCAVATION CLASSIFICATIONS:

A. The following classifications of excavation will be made when rock excavation is encountered in work.

B. Earth excavation includes excavation of pavements and other obstructions visible on ground surface; underground structures, utilities and other items indicated to be demolished and removed; together with earth and other materials encountered that are not classified as rock or unauthorized excavation.

C. Rock excavation in trenches and pits includes removal and disposal of materials and obstructions encountered which cannot be excavated with a 1.0 cubic yard (heaped) capacity, (3/4 cu. yd. backhoe for smaller work), 24" wide bucket on track-mounted power excavator equivalent to Caterpillar Model 215, rated at not less than 90 HP flywheel power and 30,000 lb. drawbar pull. Trenches in excess of 10'-0" in width and pits in excess of 30'-0" in either length or width are classified as open excavation.

D. Rock excavation in open excavations includes removal and disposal of materials and obstructions encountered which cannot be dislodged and excavated with modern track-mounted heavy-duty excavating equipment without drilling, blasting or ripping.

E. Rock excavation equipment is defined as Caterpillar Model No. 973 or No. 977K, or equivalent track-mounted loader, rated at not less than 170HP flywheel power and developing 40,000 lb. break-out force (measured in accordance with SAE J732C).

F. Typical of materials classified as rock are boulders 1.0 cu. yd. or more in volume, solid rock, rock in ledges, and rock-hard cementitious aggregate deposits.

G. Intermittent drilling, blasting or ripping performed to increase production and not necessary to permit excavation of material encountered will be classified as earth excavation.

H. Do not perform rock excavation work until material to be excavated has been cross-sectioned and classified by the Engineer.

I. Rock Payment Lines Are Limited To The Following:

1. Two feet outside of concrete work for which forms are required, except footings.
2. One foot outside perimeter of footings.
3. In pipe trenches, 6" below invert elevation of pipe 1' to either side of the pipe.
4. Neat outside dimensions of concrete work where no forms are required.
5. Under slabs on grade, verify subgrade depth requirement.
6. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific written acceptance of the Engineer or authorization by the Owner. Unauthorized excavation, as well as remedial work directed by the Engineer, shall be at the Contractor's expense.

PART 2 - MATERIALS

2.1 SELECTED FILL:

A. Selected fill is to be placed, as required, to replace deficient subsoil as directed by the Engineer. Selected fill is soil material native to the area, that is capable of being compacted to the specified densities and that is free from organic matter and other deleterious materials. Selected fill shall contain no stones larger than 2" at its greatest dimension, and shall contain no more than 10% clay or silt (passing the No. 200 sieve).

B. Local pockets of material that are substantially different in composition from the surrounding may be unsatisfactory for use as selected fill under certain climatic conditions. Do not use such materials without acceptance from the Engineer.

C. If sufficient selected fill material is not available from excavation under the Contract, additional fill suitable for use, shall be brought to the site from other sources.

PART 3 - EXECUTION

3.1 PREPARATION:

A. Establish required lines, levels, contours and datum.

B. Maintain benchmarks and other elevation control points. Re-establish, if disturbed or destroyed, at no additional cost to the Owner.

C. Establish location and extent of utilities before commencement of grading operations.

3.2 ROUGH GRADING:

A. Rough grade the project area to required subgrade levels and elevations as indicated on the drawings. The subgrades are as follows:

1. Sodded Areas: 6" below finished elevation.
2. Paved Areas: See details.

B. Prior to placing selected fill material over undisturbed soil, scarify to a depth of 6".

C. When grading operations have reached the required subgrade elevations, notify the Engineer for a review of the conditions.

D. Removal of materials beyond the indicated subgrade elevations without authorization by the Engineer will be classified as unauthorized excavation and shall be at no additional cost to the Owner.

E. Maintain slopes of excavation in safe condition until completion of grading operations.

3.3 DEWATERING:

A. Prevent surface, subsurface or ground water from flowing into excavation and from flooding project area, as well as surrounding areas.

B. Do not allow water to accumulate in excavations. Remove water to prevent soil changes detrimental to the stability of subgrades.

C. Provide, operate and maintain a temporary dewatering system including pumps, well points, sumps, suction and discharge lines, and other dewatering components necessary to convey water away from excavations and control the groundwater level so that the necessary construction work can be properly performed.

D. Provide and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations by dewatering, to collection or runoff areas.

E. Dewatering operations shall be conducted in accordance with Specification 312319 “Dewatering”

and as acceptable to the Engineer.

F. The Contractor shall be fully responsible for, and shall correct at his own expense, any and all damages that may result from the operations of his dewatering system or failure to make any provisions.

G. There shall be no discharge of silty, muddy or otherwise polluted water from any dewatering operation to a natural water course.

H. Provide, as necessary, sediment control measures to ensure that discharged waters are of the highest possible quality.

3.4 PLACEMENT AND COMPACTION:

A. Place fill materials in layers not more than 8" loose depth for material compacted by heavy construction equipment, and not more than 4" in loose depth for material compacted by hand-operated tampers.

B. Do not place fill material on surfaces that are muddy, frozen, or contain frost or ice.

3.5 PERCENTAGE OF MAXIMUM DENSITY REQUIREMENTS:

A. Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture density relationship (cohesive soils) determined in accordance with ASTM D1557; and not less than the following percentages of relative density, determined in accordance with ASTM D2419, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).

3.6 PAVEMENTS:

A. Compact top 12" of subgrade and each layer of backfill or fill material at 90% maximum density for cohesive material or 95% relative density for cohesionless material.

3.7 LAWN OR UNPAVED AREAS:

A. Compact top 6" of subgrade and each layer of backfill or fill material at 85% maximum density for cohesive soils and 90% relative density for cohesionless soils.

3.8 MOISTURE CONTROL:

A. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material, to prevent free water appearing on the surface during or subsequent to compaction operations.

B. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.

C. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by dicing, harrowing or pulverizing until moisture content is reduced to a satisfactory value.

3.9 FIELD QUALITY CONTROL:

A. The testing laboratory shall check the degree of compaction of all fill, including proof-rolling. Perform tests for each layer, of each kind of fill. Determine maximum density at optimum moisture for each material per ASTM D1557. Make field compaction tests per ASTM D1556. The in-place density specified is the relation of the field compaction test and the maximum density determination of the same soil. This testing shall be performed as requested by the Owner.

B. If in the opinion of the Engineer, based on testing service reports and inspection, subgrade or fills which have been placed are below specified density, provide additional compaction and testing at no additional cost to the Owner.

C. If so required by the Engineer, the Contractor shall at his own expense, perform turbidity sampling to ensure that the construction operations have not negatively impacted a water course.

D. At all times, special measures shall be taken to prevent spillage of chemicals, fuels, oils, greases, bituminous materials, or any deleterious materials to the environment or any water course.

3.10 CLEANUP:

A. Provide and maintain protections or newly filled areas against damage. Upon completion or when directed, correct all damaged and deficient work by building up low spots and remove temporary protections, fencing, shoring and bracing.

B. Remove all surplus excavated material not required for filling and backfilling and legally dispose of same away from premises.

C. Leave the premises and work in clean, satisfactory condition, ready to receive subsequent operations.

3.11 QUALITY CONTROL: SUPERVISION, INSPECTION, AND RECORDS:

A. The Contractor shall retain an Independent Testing Agency to perform fill sampling and testing. The work performed by the testing agency shall be supervised by a registered geotechnical engineer.

B. Test material gradation for all fill materials in accordance with ASTM 422. Sample and test a minimum of one test per every 5,000 cubic yards placed.

C. Perform compaction testing of each lift of the embankment fill and final grading in accordance with ASTM D 1556 or ASTM D 6938. Perform at least one test for every 5,000 ft^2 of surface area. Report failing tests immediately to the Engineer.

D. A complete tabulation of all test results shall be certified by the independent Testing Agency and shall be delivered to the Engineer

PART 4 - MEASUREMENT AND PAYMENT

4.1 PAYMENT:

A. Paved Areas:

1. Rough grading under and adjacent to paved areas shall be included in the unit price bid under the appropriate payment item for the paving work. If no such item exists, the work shall be deemed included in the other payment items of the Proposal.

B. Earthwork:

Rough grading related to a Site Grading Plan shall be included in the lump sum price bid under the "Earthwork" item. If no such item for payment is provided within the Proposal, and no other specific item for payment is provided, then the costs for the required rough grading shall be deemed included in the other prices bid in the Proposal, and no separate payment for this work shall be made.

END OF SECTION 312213

SECTION 312219 - FINISH GRADING (NY)

PART 1 – GENERAL

1.1 WORK INCLUDED:

A. Place, grade and compact topsoil, or other materials as may be called for, shown or required to complete the project work.

1.2 RELATED WORK:

A. Rough Grading - Section 312213

B. Erosion and Sediment Control – Section 312500

C. Seeding - Section 329219

D. Topsoil Placement and Grading (Topsoil) - Section 329119.13

1.3 EXISTING CONDITIONS:

A. It shall be the Contractor's responsibility to visit the entire project site and investigate all conditions that may affect his work.

B. The Contractor shall take all necessary as-built measurements and make all necessary investigations in the field, prior to layout of the proposed installation of the work.

1.4 COORDINATION:

A. Coordinate the finish grading with the completion of the underground and other work of the project, before final restoration or paving is begun.

1.5 REFERENCE STANDARDS:

A. The latest edition of the following standards, as referenced herein, shall be applicable.

B. "Standard Specifications, Construction and Materials, New York State Department of Transportation, Office of Engineering".

C. "Standard Specifications for Highway Materials and Methods of Sampling and Testing, American Association of State Highway and Transportation Officials (AASHTO)".

D. Requirements of Regulatory Agencies: Contractor shall comply with the requirements for soil erosion and sedimentation control and other requirements of governmental authorities having

jurisdiction, including the State of New York.

E. The following test standards apply to the work under this section:

1. ASTM D2216, “Laboratory Determination of Moisture Content of Soil.”
2. ASTM D422, “Particle-Size Analysis of Soils.”
3. ASTM D698, “Test method for Laboratory Compaction Characteristics of Soil Using Standard Effort.(Standard Proctor)
4. ASTM D1557, “Test method for Laboratory Compaction Characteristics of Soil Using Modified Effort.(Modified Proctor)
5. ASTM D2922, “Density of Soil and Soil Aggregate in Place by nuclear Methods.”
6. ASTM D2937, “Density of Soil in Place by the Drive-Cylinder Method.”
7. ASTM D3107, “Test for Moisture Content of Soil and Soil Aggregate in Place by Nuclear Methods.”

1.6 TESTING AGENCY:

A. Contractor shall provide and pay for all costs in connection with an approved independent testing facility to determine conformance of soils and aggregate with the specifications.

1.7 SUBMITTALS REQUIRED:

A. Samples: The Contractor shall furnish earth materials to the testing laboratory for their analysis and report, as directed by the Engineer.

B. Test Results: The testing laboratory shall submit written reports of all tests, investigations, findings and recommendations to the Contractor and also directly to the Engineer.

PART 2 - MATERIALS

2.1 TOPSOIL:

A. Provide topsoil which is fertile, friable, natural loam, reasonably free of subsoil, clay lumps, brush, weeds, roots, stumps and other deleterious material.

B. Topsoil shall meet the requirements specified in Topsoil Placement and Grading Specification 329119.13, unless otherwise indicated on the plans.

2.2 OTHER MATERIALS:

A. Other materials as may be involved for finish grading work shall comply with the respective and applicable provisions as noted otherwise in these documents.

PART 3 - CONSTRUCTION DETAILS

3.1 STOCKPILING:

A. Topsoil shall be stockpiled from on-site sources or provided from off-site sources and stockpiled if on-site quantities are deficient.

B. Stockpiles shall contain not less than 200 cu. yds. or the minimum required for the project.

C. Stockpiles shall have a height of at least 4' and shall be trimmed to uniform surfaces and slopes.

D. The sites of all stockpiles and areas adjacent thereto which have been disturbed by the Contractor shall be graded and put into an acceptable condition as required by the property Owner, and deemed acceptable by the Engineer.

E. Stockpiles shall be provided with suitable provisions for soil erosion prevention.

3.2 TOPSOIL PLANNING:

A. Placing topsoil on compacted subgrades conforming with Section 312213, Rough Grading, only after subgrades have been accepted by the Engineer.

B. Scarify the subgrade parallel to the contours to permit sufficient bonding with the topsoil. Do not scarify to the extent that the subgrade stability and density is disrupted.

C. Place topsoil in areas where sodding is to be performed. Place a 4" minimum depth to the finished grade elevations as required.

D. Fine grade topsoil to eliminate uneven areas and to ensure proper drainage. Maintain finished grade elevations required.

E. Remove all stones, roots, grass, weeds or other foreign matter while placing.

F. Lightly compact the topsoil to ensure its stability.

G. Topsoil in an unworkable condition due to excessive moisture, frost, or other conditions shall not be placed until it is suitable for placement.

3.3 CLEAN-UP:

A. Remove all surplus subsoil and topsoil from project site.

B. Leave the site in clean, satisfactory condition ready to receive subsequent operations.

PART 4 - MEASUREMENT AND PAYMENT

4.1 PAYMENT:

A. Earthwork: Finish grading related to completion of the project work shall be deemed included in the lump sum and unit prices bid under the proposal items. No separate payment for this work shall be made.

END OF SECTION 312219 (NY)

SECTION 312316- ROCK REMOVAL (ROCK EXCAVATION) (NY)

PART 1 – GENERAL

1.1 WORK INCLUDED:

A. Removal of rock, within the payment limits, for installation of piping as shown on the plans or called for in the Specifications.

B. Removal of rock, within the payment limits, for installation of roadway surfaces, curbing and sidewalks as shown on the plans or called for in the Specifications.

C. Removal of all other rock, for structures or other improvements designated on the plans, called for in the Specifications or indicated in the field by the Engineer.

D. Proper disposal of all excavated rock at a location acceptable to the Owner and Engineer.

E. Provide selected borrow backfill to make up for any deficiencies due pursuant to the rock excavation. In roadway areas, or where otherwise called for, utilize Roadway Subbase Material.

1.2 RELATED WORK:

A. Erosion and Sediment Control – Section 312500

B. Rough Grading – Section 312213

C. Finish Grading - Section 312219

D. Backfill (Selected Borrow Backfill) - Section 312323.13.02

E. Trenching, Backfilling and Compaction - Section 312333

1.3 EXISTING CONDITIONS:

A. Where information exists regarding the presence of rock within the work limits and same is made available by the Owner, the Engineer does not purport said information as being correct or having been verified and said information is made available only to assist the Contractor in determining those areas where previous data indicates the possibility of rock being encountered.

B. The Contractor shall, based on any subsurface information made available, make all interpretations using the information according to his own judgement.

C. The Owner and/or the Engineer shall assume no responsibility or liability pertaining to the Contractor's utilization or interpretation of any information made available.

D. The quantity indicated in the Contract Proposal is provided as an estimated quantity for the purpose of comparing bids and has been obtained using the information available at time of

design.

E. It shall be the Contractor's responsibility to investigate all site conditions that may affect his work.

PART 2 - MATERIALS:

2.1 All equipment utilized by the Contractor and/or subcontractors in his (their) performance of the work under this section shall comply with all provisions of local jurisdictions and/or agencies.

2.2 All equipment and/or procedures utilized in the possession, handling, storage and transportation of all explosives shall comply with the requirements of Industrial Code Rule 39 of the State of New York, Department of Labor, Board of Standards and Appeals, and the applicable conditions of Section 107-05 of the New York State Department of Transportation Standard Specifications.

PART 3 - CONSTRUCTION DETAILS

3.1 GENERAL:

A. The Contractor shall comply with Title 29, Code of Federal Regulations Part 1926, Safety and Health Regulations for Construction (OSHA) regarding the safety and protection of persons employed in construction and demolition work.

B. All blasting shall be done in compliance with all Federal, State and Local regulations.

C. The Contractor shall obtain all appropriate and required blasting permits from all applicable jurisdictions. The cost for all fees, bonds, etc., shall be paid for by the Contractor.

D. The Contractor shall provide any applicable supplemental Certificates of Insurance, or Certificates for the blasting subcontractor, to the Owner prior to any blasting work. All Certificates shall comply with the requirements elsewhere noted herein this document for Certificates of Insurance provided under this Contract.

3.2 PRECAUTIONS:

A. In blasting, all necessary precautions shall be taken to protect persons and property.

B. The Contractor shall take all possible precautions to prevent accidents from blasting.

C. The Contractor shall be liable for all damages done to persons and/or property caused by blasts or explosives or from neglect in properly guarding the trenches. No compensation will be allowed said Contractor for loss so incurred.

D. Blasting shall be done only by workmen skilled in this kind of work. The Owner and/or the Engineer shall have the right to require references to suitably indicate the ability of the workmen to perform the work in a safe manner.

E. Rock shall be well covered and sufficient warning shall be given to all persons within the vicinity before blasting.

3.3 DEFINITION:

A. Materials, which in the sole opinion of the Engineer cannot be excavated except by drilling and blasting or drilling and wedging, shall be considered rock. Refer to Specification 312213 “Rough Grading” for excavation classifications.

B. Boulders exceeding 1.0 cubic yards will also be considered rock.

C. Materials such as hardpan or disintegrated rock and other materials which can be broken down with picks, sledge hammers or power activated mechanical equipment will not be considered rock even if the Contractor elects to remove such materials by drilling and blasting or drilling and wedging.

D. Intermittent drilling, blasting or ripping performed to increase production and not necessary to permit excavation of material encountered will not be classified as Rock Excavation.

3.4 METHODS:

A. In general, blasts shall be covered with suitable blasting mats and/or heavy timbers.

B. No blasts are to be set off within fifty (50) feet of the pipe as laid, with the end of the pipe tightly plugged and covered during any blast nearer than one hundred (100) feet.

C. All blasting work shall be completed within the excavation before other work is started there.

D. Caps or other exploders shall in no instance be kept near a place where dynamite or explosives are stored, and no more than 100 pounds of dynamite shall be stored in the vicinity of the work at any time except by special permission.

E. If so called "wagon drills" are used, the Contractor must, at a minimum, excavate test pits on 200' centers and at all changes in alignment. These test pits must be excavated with a track mounted power excavator equivalent to a Caterpillar Model 215, rated at not less than 90HP flywheel power, and 30,000 lb. draw bar pull with a 24" wide bucket. The test pit shall be dug to refusal depth or subgrade line, whichever is less. The depth of disintegrated/fractured rock, which is able to be excavated as outlined above, shall be measured by the Engineer and averaged between successive test pits, to determine the amount and elevation of diggable rock present. If the top of rock is below the subgrade line, the next closest test pits diggable rock depth (elevation) shall be used for calculation purposes. The Engineer shall be the sole judge of when refusal is reached. The Engineer must be given a minimum of 72 hours prior written notice of test pits being dug.

F. After blasting and removal of the rock, the Contractor shall so clean the faces of the excavation that the upper surface of the rock can be easily determined for measurement. Boulders removed should be laid at the side of the trench and the Engineer notified and given ample time to measure the same.

G. When rock is encountered, it shall be stripped of all earth and left with a clean surface until the height of this surface is measured by the Engineer. The Contractor shall notify the Engineer upon same being prepared for measurement.

3.5 TIME FOR BLASTING:

A. Blasting shall only be accepted between the hours of 8:00 a.m. and 5:00 p.m. on weekdays, except holidays, unless otherwise accepted by the Engineer.

B. No blasts shall be made on Sunday under any conditions.

C. Blasting times shall conform to the conditions of the issued permit and/or any local ordinances.

D. Should the Contractor wish to perform blasting at times other than noted in A (above), a request shall be made a minimum of 48 hours in advance, with acceptance of the Engineer conditional with approval of all other jurisdictions.

3.6 LIMITS OF ROCK EXCAVATION:

A. Trenches - Trench rock shall be excavated to a point at least twelve (12) inches to the side of the pipe and six (6) inches below the pipe when laid. Minimum trench width shall be three feet (3'). Selected Borrow Backfill acceptable to the Engineer shall be used to fill the trench up to the proper grade.

B. Roadways - Rock to be excavated in road areas shall be excavated to a depth of six (6) inches below subgrade elevation and shall extend to the outside limits of the shoulder areas.

C. Sidewalks and Curb - Rock excavation within the actual areas where the curb, sidewalk or foundation material is to be placed.

D. Structures:

1. Two (2) feet outside of concrete work for which forms are required except footings.
2. One (1) foot outside perimeter of footings.
3. Underslabs on grade, verify subgrade depth requirements.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT:

A. Measurement will be made on the basis of cubic yards of non-diggable rock removed as measured by the Engineer. No separate payment will be made for test pits, exposing rock faces, etc., as required under this specification.

4.2 PAYMENT:

A. Payment for rock excavation will be made based on the unit price bid for Rock Excavation as bid in the Contract Proposal. The unit price bid shall include the cost to furnish all labor, materials, equipment, the cost for the necessary selected borrow or roadway subbase backfill, and incidental costs to complete the work.

B. In order to avoid unbalanced bids, the unit price for Rock Excavation is established at a minimum of thirty-five dollars ($35.00) and a maximum of one hundred dollars ($100.00) per cubic yard.

END OF SECTION 312316 (NY)

SECTION 312319 - DEWATERING

PART 1 - GENERAL

1.1 DESCRIPTION:

A. This section specifies performance of dewatering required to lower and control ground water table levels and hydrostatic pressures to permit excavation, backfill and construction. Control of surface water shall also be considered as part of the work under this specification.

1.2 SUMMARY:

A. The work to be completed by the Contractor includes, but is not necessarily limited to the following:
   1. Implementation of the Erosion and Sedimentation Control Plan.
   2. Dewater excavations, including seepage and precipitation.
   3. The Contractor shall be responsible for providing all materials, equipment, labor, and services necessary for care of water and erosion control. Excavation work shall not begin before the Erosion and Sedimentation Control Plan is in place.

1.3 PERFORMANCE REQUIREMENTS:

A. Dewatering system shall be of sufficient size and capacity necessary to lower and maintain ground water table to an elevation at least (1 foot) below lowest foundation subgrade or bottom of pipe trench and to allow material to be excavated, and concrete placed, in a reasonably dry condition. Materials to be removed shall be sufficiently dry to permit excavation to grades shown and to stabilize excavation slopes where sheeting is not required. Operate dewatering system continuously until backfill work has been completed.

B. Reduce hydrostatic head below any excavation to the extent that water level in the construction area is a minimum of (1 foot) below prevailing excavation surface.

C. Prevent loss of fines, seepage, boils, quick conditions or softening of foundation strata.

D. Maintain stability of sides and bottom of excavation.

E. Construction operations are performed in the dry.

F. Control of surface and subsurface water is part of dewatering requirements. Maintain adequate control so that:
   1. The stability of excavated and constructed slopes are not adversely affected by saturated soil, including water entering prepared subbase and subgrades where underlying materials are not free draining or are subject to swelling or freeze-thaw action.
   2. Erosion is controlled.
   3. Flooding of excavations or damage to structures does not occur.
   4. Surface water drains away from excavations.
   5. Excavations are protected from becoming wet from surface water, or ensure excavations are dry before additional work is undertaken.

1.4 RELATED WORK:

A. Rock Removal (Rock Excavation) - Section 312316

B. Structural Excavation, Backfill and Compaction – Section 312334

C. Trenching, Backfilling and Compaction Work – Section 312333

D. Erosion and Sediment Control – Section 312500

1.5 SUBMITTALS:

A. Drawings and Design Data:
   1. Submit drawings and data showing the method to be employed in dewatering excavated areas 14 days before commencement of excavation.
   2. Material shall include location, depth and size of wellpoints, headers, sumps, ditches, size and location of discharge lines, capacities of pumps and standby units, and detailed description of dewatering methods to be employed to convey the water from site to adequate disposal.
   3. Include a written report outlining control procedures to be adopted if dewatering problem arises.
   4. Capacities of pumps, prime movers, and standby equipment.
   5. Detailed description of dewatering procedure and maintenance method.

PART 2 - PRODUCTS (Not used)

PART 3 – EXECUTION

3.1 INSTALLATION:

A. Install a dewatering system to lower and control ground surface water in order to permit excavation, construction of structure, and placement of backfill materials to be performed under dry conditions. Make the dewatering system adequate to pre-drain the water-bearing strata above and below the bottom of structure foundations, utilities and other excavations.

B. In addition, reduce hydrostatic pressure head in water-bearing strata below structure foundations, utility lines, and other excavations, to extent that water levels in construction area are a minimum of (1 foot) below prevailing excavation surface at all times.

3.2 OPERATION:

A. Prior to any excavation below the ground water table, place system into operation to lower water table as required and operate it continuously 24 hours a day, 7 days a week until utilities and structures have been satisfactorily constructed, which includes the placement of backfill materials and dewatering is no longer required.

B. Place an adequate weight of backfill material to prevent buoyancy prior to discontinuing operation of the system.

3.3 WATER DISPOSAL:

A. Dispose of water removed from the excavations in such a manner as:
   1. Will not endanger portions of work under construction or completed.
   2. Will cause no inconvenience to Owner or to others working near site.
   3. Will comply with the stipulations of required permits for disposal of water.
   4. Will Control Runoff: The Contractor shall be responsible for control of runoff in all work areas including but not limited to excavations, access roads, parking areas, laydown, and staging areas. The Contractor shall provide, operate, and maintain all ditches, basins, sumps, culverts, site grading, and pumping facilities to divert, collect, and remove all water from the work areas. All water shall be removed from the immediate work areas and shall be disposed of in accordance with applicable permits.

B. Excavation Dewatering:
   1. The Contractor shall be responsible for providing all facilities required to divert, collect, control, and remove water from all construction work areas and excavations.
   2. Drainage features shall have sufficient capacity to avoid flooding of work areas.
   3. Drainage features shall be so arranged and altered as required to avoid degradation of the final excavated surface(s).
   4. The Contractor shall utilize all necessary erosion and sediment control measures as described herein to avoid construction related degradation of the natural water quality.

C. Dewatering equipment shall be provided to remove and dispose of all surface and ground water entering excavations, trenches, or other parts of the work during construction. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the structure to be built, or the pipe to be installed therein, is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result.

3.4 STANDBY EQUIPMENT:

A. Provide complete standby equipment, installed and available for immediate operation, as may be required to adequately maintain de-watering on a continuous basis and in the event that all or any part of the system may become inadequate or fail.

3.5 CORRECTIVE ACTION:

A. If dewatering requirements are not satisfied due to inadequacy or failure of the dewatering system (loosening of the foundation strata, or instability of slopes, or damage to foundations or structures), perform work necessary for reinstatement of foundation soil and damaged structure or damages to work in place resulting from such inadequacy or failure by Contractor, at no additional cost to Owner.

3.6 DAMAGES:

A. Immediately repair damages to adjacent facilities caused by dewatering operations.

3.7 REMOVAL:

A. Ensure compliance with all conditions of regulating permits and provide such information to the Resident Engineer. Obtain written approval from Resident Engineer before discontinuing operation of dewatering system.

END OF SECTION 312319

SECTION 312323.13.01- BACKFILL (CRUSHED STONE FOUNDATION) (NY)

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Furnish and place crushed stone foundation material at the depths and locations shown on the Plans and/or called for in the Specifications.

B. Furnish and place Crushed Stone Foundation material in areas or locations where, in the opinion of the Engineer, the subgrade will not properly support the pipe or structure.

C. As an alternate and where specific written acceptance of the Engineer is received, the Contractor shall be permitted to utilize sand as a foundation in lieu of crushed stone. At any time the material quality becomes questionable in the opinion of the Engineer, the acceptance can be withdrawn.

1.2 EXISTING CONDITIONS:

A. It shall be the Contractor's responsibility to investigate all site conditions that may affect his work.

1.3 RELATED WORK:

A. Trenching, Backfilling and Compaction - Section 312333

1.4 SUBMITTALS REQUIRED:

A. Samples: The Contractor shall furnish earth materials to the testing laboratory for their analysis and report, as directed by the Engineer.

B. Test Results: The testing laboratory shall submit written reports of all tests, investigations, findings and recommendations to the Contractor and the Engineer. The cost for the testing shall be borne by the Contractor.

PART 2 - MATERIALS

2.1 GENERAL:

A. The material shall conform to "Coarse Aggregates" Section 703-02, as specified in "Standard Specifications Construction and Materials, New York State Department of Transportation", latest edition.

B. Crushed stone material shall be approximately two-thirds (67%) of the sized stone indicated in the table below, with the remainder of mixed stone of other gradations as the Engineer may select due to the conditions.

C. Crushed stone provided shall be of the size noted below for the use indicated:

Use	Size
Piping Foundation	No. 2
Structures	No. 2
Curtain Drains	No. 3
All other uses (unless noted otherwise and subject to Engineer's acceptance)	No. 2

PART 3 - CONSTRUCTION DETAILS

3.1 GENERAL:

A. All methods utilized for the placement of crushed stone foundation material shall comply with the details shown on the Plans for the type of work being performed.

B. Placement shall strictly comply with the specific requirements of the appropriate specification section(s) for the type of work being performed.

C. Foundation material shall be well compacted and leveled so that it will properly support the pipe or structure.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Crushed stone placed to the minimum dimensions indicated on the Plans will be included under the individual prices bid for the respective Contract Items.

4.2 Crushed stone placed to a height of 24 inches above piping will be included under the unit price bid for the respective Contract Item.

4.3 Measurement for all other "additional" Crushed stone Backfill will be made on the basis of cubic yards of select borrow backfill in-place as measured by the Engineer. The Contractor is reminded that this material is to be placed only where required for the Engineer's acceptance of the work.

4.4 The Contractor is reminded that no payment will be made for Selected Borrow Backfill placed in connection with Rock Excavation, since the cost for such material is included under the Rock Excavation unit price bid.

4.5 Where no payment item is provided in the Contract Proposal, and crushed stone is necessary or required to complete the work, no separate payment will be made and such material (in-place) shall be deemed included under the other payment items of the Proposal.

END OF SECTION 312323.13.01 (NY)

SECTION 312323.13.02 - BACKFILL (SELECTED BORROW BACKFILL)

PART 1 – GENERAL

1.1 WORK INCLUDED:

A. Furnish and place selected borrow backfill at the depths and locations shown on the Plans and/or called for in the Specification.

B. Furnish and place selected borrow backfill to replace material considered by the Engineer to be unsuitable for backfill or to make up for deficiencies in quantity of suitable material where and when necessary and as required for acceptance by the Engineer.

C. Furnish and place selected borrow backfill to replace rock excavated in accordance with Section 312316, although in this case payment for select borrow is deemed included under Rock Removal.

D. Perform test pits and explorations to evaluate acceptability of borrowed material in the location the Contractor proposes to utilize for such material.

1.2 EXISTING CONDITIONS:

A. It shall be the Contractor's responsibility to investigate all site conditions that may affect his work.

1.3 RELATED WORK:

A. Trenching, Backfilling and Compaction Work - Section 312333

B. Rock Removal (Rock Excavation) – Section 312316

1.4 SUBMITTALS REQUIRED:

A. Samples: The Contractor shall furnish earth materials to the testing laboratory for their analysis and report, as directed by the Engineer.

B. Test Results: The testing laboratory shall submit written reports of all tests, investigations, findings and recommendations to the Contractor and the Engineer. The cost for the testing shall be borne by the Contractor.

PART 2 - MATERIALS

2.1 GENERAL:

A. Selected borrow consists of unclassified material containing no rock or stones over 2" of its greatest dimension and containing no humus, topsoil or other objectionable materials.

B. Shall contain no more than 10% clay or silt (passing the 200 sieve).

C. Where selected granular backfill is specified on the drawings or elsewhere in the Technical Specifications, the granular fill shall conform to this section and, in addition, the granular fill shall conform with ASTM D2487, Class III soil types; GM, GC, SM, and SC.

2.2 ACCEPTANCE:

A. All materials utilized under this Section shall be as acceptable to the Engineer.

B. A minimum of ten (10) days prior to taking any material from the source, the Contractor shall request the acceptance of the Engineer of the proposed borrow area.

C. Acceptability of the source and material will not be based only on the characteristics of the material but also on whether it will be satisfactory in that portion of trench in which it is to be used.

D. Any soil having a natural in-place moisture content in excess of 2 percent wetter than optimum moisture content, as determined by the ASTM Designation D1557, Method D, (year of latest revision) will not be considered as acceptable borrow material.

E. The Contractor shall supply any requested samples and pay for any testing laboratory fees to prove suitability of the selected borrow backfill.

F. Excavated material from the site can be used as select borrow backfill provided it is screened, tested and meets the general material requirements of this Technical Specification.

PART 3 - CONSTRUCTION DETAILS

3.1 GENERAL:

A. All methods utilized for the placement of selected borrow backfill shall comply with the details shown on the plans for the type of work being performed.

B. Placement shall strictly comply with the specific requirements of the appropriate Specification Section(s) for the type of work being performed.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT:

A. Selected Borrow Backfill placed to the minimum dimensions indicated on the Plans will be included under the individual prices bid for the respective Contract Items.

B. Selected Borrow Backfill placed to a height of 24 inches above piping will be included under the unit price bid for the respective Contract Item.

C. Measurement for all other "additional" Selected Borrow Backfill will be made on the basis of cubic yards of select borrow backfill in-place as measured by the Engineer. The Contractor is reminded that this material is to be placed only where required for the Engineer's acceptance of the work.

4.2 PAYMENT:

A. The Contractor is reminded that no payment will be made for Selected Borrow Backfill placed in connection with Rock Removal, since the cost for such material is included under the Rock Removal unit price bid.

B. The unit price bid per cubic yard shall include the cost of furnishing all labor, materials, tests and equipment necessary to complete the work. No additional payment will be made for disposal of unsuitable excavated material or for handling material to the point of placement.

C. Where no payment item is provided in the Contract Proposal, and selected borrow backfill is necessary or required to complete the work, no separate payment will be made and such material (in-place) shall be deemed included under the other payment items of the Proposal.

END OF SECTION 312323.13.02

SECTION 312323.13.03 - BACKFILL (SUBBASE MATERIAL) (NY)

PART 1 – GENERAL

1.1 WORK INCLUDED:

A. Furnish and place subbase material at the depths and locations shown on the Plans and/or called for in the Specifications.

B. Furnish and place subbase material to make up for deficiencies in the quantity of suitable subbase material or quality of subgrade where and when necessary and as required for acceptance by the Engineer.

C. Subbase material, unless otherwise noted, shall be NYSDOT Subbase Course, Item 304.15, also meeting the requirements noted herein.

1.2 EXISTING CONDITIONS:

A. It shall be the Contractor's responsibility to investigate all site conditions that may affect his work.

PART 2 - MATERIALS

2.1 MATERIALS REQUIREMENTS:

A. Materials for subbase course shall consist of sand and gravel, approved blast furnace slag or stone. All materials furnished shall be well graded from coarse to fine and free from organic or other deleterious materials.

B. It shall be the Contractor's responsibility to provide material which meets this specification and is within his capabilities to fine grade to the required tolerances. Should the subbase course become unstable at any time prior to the placement of the overlying course due to the gradation of the material furnished, the Contractor shall, at his own expense, correct the unstable condition to the satisfaction of the Engineer.

C. Materials furnished for Types 1 and 4 shall consist of approved blast furnace slag, stone, sand and gravel or blends of these materials. Material furnished for Type 2 shall consist solely of acceptable blast furnace slab or of stone which is the product of crushing ledge rock.

D. Gradation:

Type	Sieve Size Designation	Percent Passing by Weight
1	3 inch (75mm)	100
	2 inch (50mm)	90-100
	1/4 inch (6.3mm)	30-65
	No. 40	5-40
	No. 200	0-10

2	2 inch (50mm)	100
	1/4 inch (6.3mm)	5-60
	No. 40	5-40
	No. 200	0-10
4	2 inch (50mm)	100
	1/4 inch (6.3mm)	30-65
	No. 40	5-40
	No. 200	0-10

D. Soundness:

1. Material for Types 1, 2, and 4 will be accepted on the basis of a Magnesium Sulfate Soundness Loss after 4 cycles of 20 percent or less.

E. Plasticity Index:

1. The Plasticity Index of the material passing the No. 40 mesh sieve shall not exceed 5.0.

F. Elongated Particles:

1. Not more than 30 percent, by weight, of the particles retained on a 1/2 inch sieve shall consist of flat or elongated particles. A flat or elongated particle is defined herein as one which has its greatest dimension more than 3 times its least dimension. Acceptance for this requirement will normally be based on a visual inspection by the Engineer. When the Engineer elects to test for this requirement, material with a percentage greater than 30 will be rejected.

2. All material shall meet the specified gradation prior to placement on the grade. All processing shall be completed at the source.

PART 3 - CONSTRUCTION DETAILS

3.1 GENERAL:

A. All methods utilized for the placement of subbase course shall comply with the details shown on the plans for the work being performed.

B. Placement shall strictly comply with the specific requirements of the appropriate specification section(s) for the work being performed.

C. Subbase material shall be compacted and leveled so that it will properly support the pavement structure or other improvement as indicated on the Plans.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Subbase Material placed to the minimum dimensions indicated on the Plans will be included under the individual prices bid for the respective Contract Items.

4.2 Subbase material placed to the minimum requirements and dimensions shown on the drawings for pavement restoration or new pavement construction shall be included in the unit price bid for the applicable pavement Item.

4.3 Measurement for all other "Additional" Subbase Material will be made on the basis of cubic yards of material in-place as measured by the Engineer. The Contractor is reminded that this "additional" material is to be placed only where required for the Engineer's acceptance of the work.

4.4 The unit price bid per cubic yard shall include the cost of furnishing all labor, materials, tests and equipment necessary to complete the work. No additional payment will be made for the excavation and disposal of unsuitable excavated material or for handling the material to the point of placement.

END OF SECTION 312323.13.03

SECTION 312333 - TRENCHING, BACKFILLING AND COMPACTION WORK (NY)

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Excavate for all pipe lines, conduits, culvert pipes, utility, walls, structures and other improvements shown on the Plans or called for in the Specifications.

B. Excavate within the limits of the Contract as necessary for the completion of the work.

C. Place and thoroughly compact granular beds and fills over the pipes, services or other improvements, to rough grade elevations after satisfactorily testing.

D. Dewater excavations so that no piping, conduit, concrete work, etc. is installed in water and so that a firm stable, firm bedding is provided.

1.2 EXISTING CONDITIONS:

A. Locations of existing underground utilities are shown in an approximate way only.

B. The Contractor shall determine the exact location of all existing utilities before commencing work. The Contractor shall also consult with applicable Utility Companies for locations.

C. The Contractor shall notify UDig NY Center a minimum of three (3) working days prior to the work.

D. The Contractor agrees to be fully responsible for any and all damage, which might be caused by his failure to exactly locate and preserve any and all underground Utilities.

E. It shall be the Contractor's responsibility to investigate all site conditions that may affect his work.

1.3 RELATED WORK:

A. Rough Grading – Section 312213

B. Rock Removal – Section 312316

C. Dewatering – Section 312319

D. Backfill (Crushed Stone Foundation) – Section 312323.13.01

E. Backfill (Selected Borrow Backfill) – Section 312323.13.02

1.4 REFERENCE STANDARDS:

A. The following test standards apply to the work under this section:

1. ASTM D2216, “Laboratory Determination of Moisture Content of Soil.”
2. ASTM D422, “Particle-Size Analysis of Soils.”
3. ASTM D698, “Test method for Laboratory Compaction Characteristics of Soil Using Standard Effort.(Standard Proctor)
4. ASTM D1557, “Test method for Laboratory Compaction Characteristics of Soil Using Modified Effort.(Modified Proctor)
5. ASTM D2922, “Density of Soil and Soil Aggregate in Place by nuclear Methods.”
6. ASTM D2937, “Density of Soil in Place by the Drive-Cylinder Method.”
7. ASTM D3107, “Test for Moisture Content of Soil and Soil Aggregate in Place by Nuclear Methods.”

1.5 SUBMITTALS REQUIRED:

A. Samples: The Contractor shall furnish earth materials such as select backfill if required to the testing laboratory for their analysis and report, as acceptable to the Engineer.

B. Test Results: The testing laboratory shall submit written reports of all tests, investigations, findings and recommendations to the Contractor and the Engineer.

C. Original signed copies of all reports shall be sent directly to the Engineer.

D. Design drawings showing the spacing of all whalers, bracing or other structural components required for all sheeting (wood or steel) shall be provided bearing the original seal and signature of a licensed P.E. in the State of New York. Said drawings shall be placed on record for the project; the Owner nor their agents will review or approve same as a function of their responsibilities. The Contractor shall be fully responsible for the safety of the project operations, as noted under Section 7 of the General Conditions.

1.6 PROJECT REQUIREMENTS:

A. Protect excavations by shoring, bracing, sheet piling, underpinning or by other methods, as required to ensure the stability of the excavation.

B. Underpin or otherwise support structure and other facilities and lines adjacent to the excavation which may be damaged by the excavation. This includes service lines.

C. Immediately notify the Engineer of any unexpected subsurface conditions.

D. Existing Utilities: Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations. Comply with OSHA requirements:

E. Should uncharted or incorrectly charted piping or other utilities be encountered during

excavation, consult utility owner immediately for directions.

F. Cooperate with the Owner and utility companies in keeping respective services and facilities in operation.

G. Repair damaged utilities to satisfaction of utility owner; at no cost to the Owner.

H. Do not interrupt existing utilities serving facilities occupied and used by the Owner or others, during occupied hours, except when permitted in writing by the Owner and then only after acceptable temporary utility services have been provided.

I. Provide a minimum of 48-hour notice to the Owner and receive written notice to proceed before interrupting any utility.

J. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for temporary shutoff of services if lines are active.

1.7 USE OF EXPLOSIVES:

A. Do not bring explosives onto site or use in work without prior written permission from authorities having jurisdiction. Contractor is solely responsible for handling, storage, and use of explosive materials when their use is permitted.

B. Obtain all necessary permits, bonds, Certificates of Insurance and other such authorizations and pay all necessary fees and costs as required by all applicable jurisdictions.

1.8 PROTECTION:

A. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with warning lights.

B. Operate warning lights as recommended by authorities having jurisdiction.

C. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

D. Perform excavation within drip-line of large trees to remain by hand, and protect the root system from damage or dryout to the greatest extent possible. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1" diameter and larger with emulsified asphalt tree paint.

1.9 EXCAVATION CLASSIFICATIONS:

A. The following classifications of excavation are applicable to this project:

1. Unclassified Excavation - Includes excavation of earth, pavements and other obstructions

visible or not visible on ground surface; underground structures, utilities and other items indicated to be demolished and removed; together with any other earth or other materials encountered that are not classified as rock or unauthorized excavation.

2. Rock Excavation - Includes removal and disposal of materials and obstructions encountered, which in the opinion of the Engineer, cannot be excavated except by drilling and blasting or drilling and wedging (as further defined under Section 312316 “Rock Removal”).
3. Unauthorized Excavation - Consists of the removal of materials beyond indicated subgrade elevations or dimensions without specific acceptance of the Engineer. Unauthorized excavation, as well as the remedial work required to obtain acceptance from the Engineer, shall be at the Contractor's expense.

PART 2 – MATERIALS:

2.1 BEDDING MATERIAL:

A. Crushed stone shall conform to the requirements of the Standard Specification's Construction and Materials, New York State Department of Transportation and the requirements of Section 312323.13.01, "Backfill (Crushed Stone Foundation)".

B. Sand shall conform to the requirements of NYSDOT Section 703-06 and meet the requirements following gradation requirements:

Sieve Size	% Passing
1/4"	100
No. 50	0-35
No. 100	0-10

2.1 BACKFILL MATERIALS:

A. Selected Borrow Backfill and Selected Granular Backfill: Selected fill is soil material native to the area, that is capable of being compacted to specified densities and that is free from organic matter, humus, topsoil, and other deleterious materials. Selected fill shall conform to Section 312323.13.02 Backfill (Selected Borrow Backfill).

B. If sufficient selected fill material is not available from excavation under the contract, additional fill suitable for use, shall be brought to the site from other sources. Additional or separate payment for such materials shall only be made where so provided in the Contract Proposal.

PART 3 - CONSTRUCTION DETAILS

3.1 PREPARATION:

A. All subgrades shall be formed of suitable material free from sod, roots, stumps, trees, brush and frozen soil or any other objectionable material.

B. All techniques and equipment used to place the material shall provide an embankment uniformly compacted to the required grades.

C. Any portion of subgrade which, in the opinion of the Engineer, has been damaged by the Contractor's equipment in the progress of his work shall be corrected to the satisfaction of the Engineer by the Contractor.

D. The Contractor shall:

1. Establish extent of excavation by area and elevation as indicated on the drawings.
2. Set required lines and elevations.
3. Maintain benchmarks and other elevation control points. Re-establish, if disturbed or destroyed, at no additional cost to the Owner.
4. Accurately determine all existing utility line elevations and locations prior to any excavation or work being undertaken.

3.2 TRENCHING:

A. Excavation:

1. Dig trenches to the uniform width required for particular item to be installed, sufficiently wide to provide ample working room. Provide 12" clearance on both sides of pipe or conduit.
2. Excavate the trenches to depth indicated or required. Carry the depth of trenches for piping to establish indicated flow lines and invert elevations.
3. Trim and shape trench bottoms and leave free of irregularities, lumps, and projections.
4. Stockpile excavated subsoil for reuse where required. Remove excess or unsuitable excavated subsoil from site.
5. Do not backfill trenches until tests and inspections have been made.
6. The Contractor shall conduct all rock excavation operations, including blasting, in strict accordance with all State and Local laws and ordinances and he shall exercise maximum precautions including the use of mats in order to avoid damage to property and utilities.
7. The bottom of the excavation shall not be disturbed and the final removal of material to grade shall not be made until just before the pipe, structure or improvement is to be placed.
8. Removing and loosening material on the back slopes of cut sections shall be avoided, and any such material removed or loosened shall be replaced and thoroughly compacted to the required cross section at the Contractor's expense.

B. Stability of Excavation:

1. The Contractor shall be responsible for providing a safe and prudent excavation operation in a manner so that the workers, public and authorities will be protected from unreasonable hazard.
2. Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Comply with OSHA requirements.
3. Maintain sides and slopes of excavation in safe condition until completion of backfilling.
4. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights stringers, and cross-braces, in good serviceable condition.
5. Establish requirements for trench shoring and bracing to comply with local codes and authorities having jurisdiction.
6. For the safety of personnel, sheeting shall be used as required in any trench or excavation more than five (5) feet above the personnel's footing.

3.3 DRAINAGE AND DEWATERING:

A. The Contractor shall maintain all excavations, slopes and all surfaces such that satisfactory drainage is insured at all times.

B. Temporary facilities shall be provided when the Contractor finds it is necessary to interrupt the existing sewers, drainage pipes or surface drainage facilities and these temporary facilities shall be considered incidental to the construction of the project.

C. The Contractor shall excavate and dispose of seepage pockets of soft, wet, unstable materials, as acceptable to the Engineer. The excavated areas shall be immediately backfilled and covered with accepted granular material as necessary for acceptance by the Engineer.

D. In addition the Contractor shall:

1. Prevent surface, subsurface or ground water from flowing into excavation and from flooding project area, as well as surrounding areas.
2. Not allow water to accumulate in excavations.
3. Remove water to prevent soil changes detrimental to the stability of subgrades.
4. Provide, operate and maintain a temporary dewatering system including pumps, well points, sumps suction and discharge lines, and other dewatering components necessary to convey water away from excavations and control the groundwater level so that the necessary construction work can be properly performed.
5. Provide and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations by dewatering, to collecting or run-off areas.
6. Ensure that no damages result from improper drainage and dewatering implementation; the Contractor shall be fully responsible for, and shall correct at his own expense, any and all such damages which may result from his operations or failure to make any provisions.

E. Dewatering operations shall be in accordance with Specification 312319 “Dewatering”, and as

acceptable to the Engineer.

F. The Contractor shall be fully responsible for the diversion of all drainage flows. The Contractor shall maintain the efficiency of all existing drainage systems both underground and surface.

G. There shall be no discharge of silty, muddy or otherwise polluted water from any dewatering operation to any natural water course. Temporary facilities to prevent same shall be understood as a requirement of their project, provided at no cost to the Owner.

H. Provide, as necessary and acceptable to the Engineer, sediment control measures to ensure that discharged waters are of the highest possible quality.

3.4 BEDDING:

A. Place the type and thickness of bedding as indicated on the drawings.

B. Place systematically to create a uniform stable surface true to grade to ensure proper bedding of the pipe, structure or improvement.

3.5 PLACEMENT OF PIPE (GENERAL):

A. All pipe shall be placed in accordance with the specific requirements of the applicable technical specification section.

B. All pipe shall be inspected prior to being placed in the trench. Defective materials shall be immediately removed from the project site.

C. All pipe shall be laid at the location and grade shown on the plans and as necessary for completed work acceptable to the Engineer.

D. A suitable base in conformance will any details shown, shall be provided to support the pipe throughout its entire length.

E. All work shall be subject to testing and acceptance of Engineer and all applicable authorities.

3.6 PLACEMENT OF PIPE:

A. Unless specifically noted otherwise in other Specification sections, placement shall at minimum comply with these requirements.

B. Special care shall be exercised in placing and compacting of the material immediately adjacent to the pipe in order to avoid damage, either to the pipe or its alignment.

C. Any pipe that is damaged or moved out of alignment, regardless of cause, shall be replaced at no cost to the Owner.

D. All culverts shall be completed, backfilled and compacted before the road is rough graded.

E. Only if no other requirements are delineated in other Specification Sections and no details are provided; at minimum, in backfilling, loose, selected fine earth backfill free from stones shall be placed manually to a point two (2) feet above the top of pipes. From the bottom of the trench to the spring line of the pipe, the filling shall be thoroughly compacted by the use of tampers or similar implements and shall be brought up evenly on both sides of the pipe. The balance of the trench may be filled with "run-of-trench" materials, well compacted, except that no stone or rock shall be greater than 4" at its greatest dimension.

3.7 BACKFILLING:

A. Backfill excavation as promptly as work permits, but not until completion of the following:

1. Observation, testing, acceptance, and recording locations of underground improvements by the Contractor for the as-built drawings required under Section 7.12 of the Contract Documents, or for measurement taken by the Owner or the Engineer for the records or purposes.
2. Removal of concrete formwork.
3. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.
4. Removal of trash and debris.

B. The type of materials to be used in bedding, filling and backfilling at the structures, culverts, pipes or other improvements and the procedure of placement shall be in strict accordance with the details shown as noted on the plans and/or in the specifications.

C. Ensure trenches are free of snow, ice and water and that ground surface are not frozen.

D. Fill and backfill within, around and including that against the exterior of foundation walls shall be placed in uniform horizontal layers not exceeding six (6) inches in thickness before compaction. The material shall be spread on the existing subgrade after all sod, topsoil and unsuitable material has been stripped and removed. All portions of each layer shall be compacted with a minimum of three (3) passes of an acceptable vibrating roller. In areas inaccessible to the roller, a vibrating plate compactor or an impact rammer shall be used.

E. Otherwise, place backfill and fill materials in layers not more than 9" in loose depth for material compacted by heavy compaction equipment, and not more than 6" in loose depth for material compacted by hand-operated tampers.

F. In backfilling, special care shall be taken to thoroughly compact the material. No refilling shall be made with frozen earth, and no refilled trench shall contain more than one-third (1/3) stone, unless otherwise acceptable to the Engineer. Material in the opinion of the Engineer to be unsuitable for backfilling shall not be used.

G. Place backfill to the subgrade elevations of further indicated work.

H. Use care in backfilling to avoid damage or displacement of pipe systems.

I. Maintain optimum moisture content of fill materials in order to attain required compaction density.

J. Compact in conformance with specific requirements noted hereinbelow.

K. Remove surplus fill materials from site to a proper disposal area.

3.8 COMPACTION:

A. A thoroughly and satisfactorily compacted earth subgrade is defined as having a minimum dry density of 90 percent of the maximum density. However, where the material consists of sand and gravel mixtures containing less than 20 percent, by weight, of particles passing the No. 200 mesh sieve, as determined by washing through the sieve in accordance with ASTM Designation D1140 (latest revision), a minimum dry density of 95 percent of the Maximum Density will be required. The in-place density shall be determined by ASTM Designation D 6938 (latest revision).

B. All fill material shall be compacted at a moisture content suitable for obtaining the required density. In no case, shall the moisture content be less than three (3) percent drier than the Optimum Moisture Content determined by the ASTM Designation D1557(latest revision), Method D.

C. When the moisture content of the material in the layer is less than the required amount, water shall be added by pressure distributors or other equipment; water may be added also in excavation or borrow pits. Water shall be uniformly and thoroughly incorporated into the soil by discing, harrowing, blading or by other acceptable means. This manipulation may be omitted for coarse and gravel soils. When the moisture content of material is in excess of the required Optimum amount, dry material shall be thoroughly incorporated into the wet material, or wet material shall be dried to the required Optimum by evaporation.

D. Any method or combination of methods used for the purpose of drying shall be subject to acceptance by the Engineer.

E. Maximum Density is defined as the maximum dry weight density in pounds per cubic foot as determined by ASTM D-1557 (latest revision), Method D.

F. Embankments - Where the subgrade material contains less than one third (1/3), by volume, of stones or rocks larger than six (6) inches in greatest dimension, it shall be placed in successive uniform layers not exceeding eight (8) inches in thickness, loose measure, over the entire area of the embankment. Each layer shall be thoroughly rolled over its entire area with equipment intended for use to provide a uniformly compacted embankment, as acceptable to the Engineer. Equipment must be on the site prior to the start of construction of any embankment. All equipment must be in good working order. Pneumatic tired rollers shall have an operating weight of not less than 1000 pounds per tire. Smooth steel wheel rollers shall have a minimum weight of ten (10) tons and shall exert pressure of not less than 300 pounds per lineal inch of compression wheel or roll width.

G. All testing required to demonstrate compaction in compliance with these specifications shall be provided at the expense of the Contractor.

3.9 FIELD QUALITY CONTROL:

A. The testing laboratory shall check the degree of compaction of all fill, including proof-rolling. Perform tests for each layer, of each kind of fill. Determine maximum density at optimum moisture for each material per ASTM D1557. Make field compaction tests per ASTM D 6938. The in-place density specified is the relation of the field compaction test and the maximum density determination of the same soil. This testing shall be performed as requested by the Engineer.

B. If, in the opinion of the Engineer, based on testing service reports and inspection, subgrade or fills which have been placed are below specified density, provide additional compaction and testing at no additional cost to the Owner.

PART 4 - MEASUREMENT AND PAYMENT

4.1 PAYMENT:

A. Payment for all Trenching, Backfilling and Compaction shall be included in the individual prices bid in the Proposal.

B. It is possible that groundwater will be encountered on the project site. Any costs incurred for the dewatering of excavations and for the installations, operation and maintenance of any and all dewatering facilities shall be deemed included in the prices bid in the proposal.

C. For all timber used for sheeting, bracing, etc., which is not shown upon the drawings to be left in place and which shall not be left as necessary for acceptance of the Engineer or as noted in writing to be left in place during the progress of the work, but which shall be actually left in the ground for convenience or to serve the interests of the Contractor, the Contractor shall receive no payment, it being understood and agreed that his compensation therefore is included in the prices bid in the Proposal.

D. There will be no separate payment made for any work, materials or testing required for compliance with this Section.

END OF SECTION 312333 (NY)

SECTION 312334 - STRUCTURAL EXCAVATION, BACKFILL AND COMPACTION

PART 1 – DESCRIPTION

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK:

A. This Section pertains to an area bound by the exterior limit of excavation of each structure. including, but not limited to buildings, tanks, channels, troughs, precast box culverts. bridge abutments, wingwalls, and elements attached to structures.

B. This work includes the following:

1. Preparing subgrade for structures, slabs, walks, and pavements.
2. Preparing subbase and drainage fill beneath foundation footings, slabs, and pavements.
3. Excavating and backfilling for structure.
4. Excavating and backfilling of trenches within structure lines.
5. Excavating and backfilling for underground mechanical utilities and buried mechanical appurtenances.
6. Excavating and Backfilling for Mechanical, Electrical, and Plumbing Work: Refer to Divisions 22, 23 and 26 sections for excavation and backfill required in conjunction with underground mechanical, electrical and plumbing utilities and buried mechanical, electrical, and plumbing appurtenances.
7. Final Grading, together with placement and preparation for topsoil for lawns and planting, is specified in Division 32 Sections.

1.3 RELATED SECTIONS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Rock Excavation – Section 312316

C. Backfill (Selected Borrow Backfill) - Section 312323.13.02

D. Trenching, Backfill and Compaction Work – Section 312333

E. Backfill (Subbase Material) – Section 312323.13.03

F. Topsoil Placement and Grading (Topsoil) - Section 329119.13

G. All other sections of this document for which excavation, backfilling or compaction work is

called for or required or is related and applicable.

1.4 REFERENCE STANDARDS:

A. The following test standards apply to the work under this section:

1. ASTM D2216, “Laboratory Determination of Moisture Content of Soil.”
2. ASTM D422, “Particle-Size Analysis of Soils.”
3. ASTM D698, “Test method for Laboratory Compaction Characteristics of Soil Using Standard Effort. (Standard Proctor)
4. ASTM D1557, “Test method for Laboratory Compaction Characteristics of Soil Using Modified Effort. (Modified Proctor)
5. ASTM D2922, “Density of Soil and Soil Aggregate in Place by nuclear Methods.”
6. ASTM D2937, “Density of Soil in Place by the Drive-Cylinder Method.”
7. ASTM D6938, “Test for Moisture Content of Soil and Soil Aggregate in Place by Nuclear Methods.”
8. ASTM D4253 “Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.”

1.5 QUALITY ASSURANCE:

A. Comply With: NYSDOT "Standard Specification for Construction and Materials".

B. Routine testing of existing soils, and compacted material for compliance with these Specifications shall be performed by a testing agency acceptable to Engineer.

C. Compacted material which does not meet density requirements shall be removed and/or re-compacted, and re-tested.

D. Testing agency shall be employed by contractor to perform the following services:

1. Test materials proposed for use by Contractor to verify specified requirements and determine optimum moisture at which maximum density can be obtained in accordance with ASTM D 1557, Modified Proctor.

2. Perform field density tests for any fill material outside of the structure area.

E. Testing agency shall be employed by Owner to perform Special Inspections noted on the drawings and the following services:

1. Perform field density and bearing capacity tests for footing subgrade, and field density tests for all fill material within structure area.

a. For footing subgrade and for each stratum of soil on which footings will be placed, conduct minimum of one field density test of each spread footing, and one test per 20-foot length of strip footing.

b. For structure subgrade and for each lift of compacted material, conduct one field density test for every 1,000 sq. ft. of structure area, but not less than four tests.

2. Verify placement of each layer of drainage course and subbase to required cross sections and thicknesses and compaction.

3. The testing agency shall inspect and approve each subgrade and fill layer before further backfill or construction work is performed. Approval shall be based on satisfactory achievement of compaction criteria and achievement of required bearing strength. Notify Engineer of any remedial action required prior to performance of work.

4. Testing agencies shall submit copies of reports within 7 days of test to Owner, Contractor, Geotechnical Engineer, and Engineer. Include dates of site visit, description of work observed and summary of observations. Include dates of testing, location, elevation, and readings of all tests performed.

F. A licensed professional Geotechnical Engineer will be employed by the Owner/Engineer for quality control and to review test data provided by the testing agency.

1. Geotechnical Engineer shall be present during proof-rolling and when subgrade is exposed to identify soils requiring undercutting and replacement.

2. Geotechnical Engineer shall review and approve all materials proposed by Contractor for use as compacted fill based on test data and information submitted by testing agency.

3. Geotechnical Engineer shall verify footing bearing stratums; review and approve filling and compaction procedures; and be present to review and approve preparation of slab-on-grade subgrade and subbase.

1.6 DEFINITIONS:

A. Excavation consists of removal of material encountered to subgrade elevations indicated and subsequent disposal of materials removed.

B. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be at Contractor's expense.

1. Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position, when acceptable to Engineer.
2. In locations other than those above, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Engineer.

C. Additional Excavation: When excavation has reached required subgrade elevations, notify Engineer and Geotechnical Engineer, who will make an inspection of conditions. If

Geotechnical Engineer determines that bearing materials at required subgrade elevations are unsuitable, continue excavation until suitable bearing materials are encountered and replace excavated material as directed by Geotechnical Engineer/Engineer. The Contract Sum may be adjusted by an appropriate contract modification.

D. Removal of unsuitable material and its replacement as directed will be paid on basis of Conditions of the Contract relative to changes in work.

E. Subgrade: The undisturbed earth or the compacted soil layer immediately below granular subbase, base of structure, or topsoil materials.

F. Structure: Buildings, foundations, slabs, tanks, curbs, walks, or other man-made stationary features occurring above or below ground surface.

1.7 RESPONSIBILITIES OF CONTRACTOR:

A. Advise testing agency/Special Inspector sufficiently in advance of operation to allow assignment of personnel. Coordinate daily testing requirements with testing service.

B. Advise Geotechnical Engineer sufficiently in advance of operation to schedule inspections and review of work specified.

C. Use of testing services and review by Geotechnical Engineer shall in no way relieve Contractor of his responsibility to furnish materials and construction as specified.

1.8 PROJECT CONDITIONS:

A. Site Information: Subsurface investigation reports were used for the basis of the design and are available to the Contractor for information only. Conditions are not intended as representations or warranties of accuracy or continuity between soil borings. The Owner will not be responsible for interpretations or conclusions drawn from this data by Contractor.

1. Additional test borings and other exploratory operations may be performed by Contractor, at the Contractor's option; however, no change in the Contract Sum will be authorized for such additional exploration.

B. Existing Utilities: Locate existing underground utilities in area of Work before starting earthwork operations. Where utilities are to remain in place, provide adequate means of protection during earthwork operations.

1. If uncharted, or incorrectly charted, piping or other utilities are encountered during excavation, consult utility owner and Engineer immediately for directions. Cooperate with Owner, and public and private utility companies to keep their respective services and facilities in operation. Repair damaged utilities as required by utility owner, at the sole expense of the Contractor.
2. Do not interrupt existing utilities serving facilities occupied by Owner or others, during occupied hours, except when permitted in writing by Engineer and then only after

acceptable temporary utility services have been provided.

3. Provide minimum of 48-hour notice to Engineer and Owner, and receive written notice to proceed before interrupting any utility.
4. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shutoff of services if lines are active.

C. Use of Explosives: is not permitted.

D. Protection of Property: Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

E. Perform excavation by hand within dripline of large trees to remain. Protect root systems from damage or dry out to the greatest extent possible. Maintain moist condition for root system and cover exposed roots with moistened burlap.

PART 2 - MATERIALS

2.1 SELECT FILL:

A. Select fill shall meet the minimum design criteria indicated on the project plans.
B. Select fill shall be free of organics and other deleterious materials.
C. Select fill material specification shall be submitted to the Engineer for approval prior to use on site.

2.2 SUBBASE MATERIAL (CRUSHED STONE):

A. Typical of NYSDOT Item #4 or;
B. Sand and gravel which is sound, durable, and free of organic and other deleterious materials conforming to the following limits of gradation:

Percent Passing by Weight	Sieve Size
100	2"
30 to 65	1/4"
5 to 40	No. 40
0 to 10	No. 200

2.3 DRAINAGE FILL (CLEAN STONE):

A. Typical of AASHTO #57 Stone or;
B. Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100 percent passing a 1-1/2 inch sieve and not more than 5 percent passing a No. 4 sieve.

2.4 FILTER FABRIC:

A. Mirafi 140N by Mirafi, Inc., or accepted equivalent.

2.5 DRAINAGE PIPE:

A. 4-inch diameter perforated pipe.

2.6 EXCAVATED MATERIALS:

A. Do not use as select fill or subbase material, unless approved by engineer. The contractor's testing agency shall sample materials and perform testing to determine compliance with fill specifications listed in this section. Submit testing results to engineer for approval.

2.7 VAPOR BARRIER: Provide vapor barrier cover over prepared base material where indicated below slabs on grade. Use only materials that are resistant to deterioration when tested in accordance with ASTM E 154, as follows:

A. Polyethylene sheet not less than 10 mils thick, or as indicated on the plans.

B. Water-resistant barrier consisting of heavy Kraft papers laminated together with glass-fiber reinforcement and overcoated with black polyethylene on each side. Moistop by Fortifiber Corp. or accepted equivalent.

PART 3 – EXECUTION

3.1 JOB CONDITIONS:

A. Examine all substrates and conditions under which Work shall be performed. Do not proceed with Work until all unsatisfactory conditions are corrected.

B. Drainage shall be maintained and traffic within building area shall be restricted during construction to maintain integrity of subgrade. Failure to observe these precautions will require Contractor, at his own expense, to remove disturbed areas and correct.

3.2 COLD WEATHER PROTECTION:

A. Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F.

3.3 REMOVALS:

A. Clear, grub, and strip site of vegetation, topsoil, and other organic materials per specific specification.

B. Remove all brick fragments and other construction debris. Plow, strip, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that fill material will bond with existing surface.

C. When existing ground surface has a density less than that specified for particular area classification, break up ground surface, pulverize, moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density.

D. Removal from Owner's Property: Remove waste materials, including unacceptable excavated material, trash, and debris, and dispose of it off Owner's property, at the Contractor's expense.

3.4 EXCAVATION:

A. Excavation shall be considered unclassified and understood to mean any and all materials encountered during excavation.

B. Excavation Classifications: The following classifications of excavation will be made when rock is encountered:

1. Earth excavation includes excavation of pavements and other obstructions visible on surface; underground structures, utilities, and other items indicated to be demolished and removed; together with earth and other materials encountered that are not classified as rock or unauthorized excavation.
2. Rock excavation for trenches and pits includes removal and disposal of materials and obstructions encountered in accordance with the specific technical specifications.

C. Shoring and Bracing: Provide materials for shoring and bracing, such as sheet piling, uprights, stringers, and cross braces, in good serviceable condition. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Extend shoring and bracing as excavation progresses.

3.5 DEWATERING:

A. As specified in Division 31 “Dewatering”.

3.6 PROOF ROLLING:

A. Following stripping and removal of miscellaneous fill, grade, and compact exposed subgrade.

B. Proof roll subgrade by making five passes across the building area in each direction using a

smooth drum vibrating roller having a static weight of at least 10 tons.

C. All soft spots which develop during proof rolling shall be undercut and replaced with compacted select fill if under slabs or compacted subbase material if under foundations and footings.

D. Proof rolling shall not be performed during or immediately after periods of inclement weather.

3.7 FILLING, BACKFILLING AND COMPACTION:

A. Do not place fill material on surfaces that are muddy, frozen, or contain frost or ice.

B. Place soil stabilization geotextile below structural fill if required after subgrade has been approved and before placement of fill material.

C. Use select fill to increase grades within structure areas, as interior backfill against foundations and in trenches, as exterior backfill against walls, as exterior backfill where pavement or walkways abut the structure, and where indicated on Drawings.

D. Use subbase material to increase grades and establish bearing elevation above exposed subgrade beneath footings and foundations, and where indicated on Drawings.

E. Use drainage material directly below slabs and pad as indicated on Drawings.

F. Use select fill material to increase grades outside the structure area, except as otherwise specified.

G. Use drainage fill around footing drains or as detailed on Drawings. Wrap footing drains and drainage fill with filter fabric. Prewrapped footing drains shall not be used. Where the perimeter pipe is bedded in native soil, the bottom of the trench should be left uncompacted.

H. Backfill trenches with lean concrete where trench excavations pass within 18 inches footings and that are carried below bottom of such footings or that pass under wall footings. Place concrete to level of bottom of adjacent footing.

I. Backfill foundation excavations as soon as possible following construction of foundations and foundation walls.

J. Backfill and fill against foundation walls evenly on both sides to prevent any displacement of construction. Do not backfill walls with fill on one side only until concrete has achieved 70 percent of its design strength.

K. Begin filling in the lowest section of the area.

L. Place fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

M. Scarify the surface of the subgrade and of each lift of fill, prior to placing the next lift to promote

vertical drainage.

N. Any lift or portion thereof, which is not compacted in accordance with Specifications shall be re-compacted or removed and replaced to meet compaction requirements.

O. Percentage of Maximum Density Requirements: Compact soil and fill to not less than the following percentages of maximum density, in accordance with ASTM D 1557:

1. Under structures, building slabs and steps, and pavements, compact top 12 inches of subgrade and each layer of fill material at 95 percent maximum density.
2. Under walkways, compact top 6 inches of subgrade and each layer of fill material at 95 percent maximum density.

P. Where a power roller is used for compaction, do not approach nearer than 10 feet from the walls of new or existing construction.

Q. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade of layer of soil material. Apply water in minimum quantity as necessary to prevent free water from appearing on surface during or subsequent to compaction operations.

R. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.

S. Stockpile or spread soil material that has been removed because it is too wet to permit compaction. Assist drying by discing, harrowing, or pulverizing until moisture content is reduced to a satisfactory value.

3.8 DRAINAGE FILL:

A. Place drainage fill material on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade and precast concrete structures as follows:

1. Place drainage course 6 inches or less in compacted thickness in a single layer.
2. Place drainage course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
3. Compact each layer of drainage course to required cross sections and thicknesses to not less than 70 percent of relative density according to ASTM D 4253.

C. Where footings and foundations bear directly on native subgrade materials, contractor may over-excavate and cap subgrade with compacted drainage fill to protect native materials from disturbance and mitigate mud from forming in the excavation.

D. Place soil stabilization geotextile above drainage fill if required additional fill material is to be placed above it to prevent loss of fines.

3.9 VAPOR BARRIER INSTALLATION:

A. General: Following leveling and tamping of granular base for slabs on grade, place vapor retarder/barrier sheeting with longest dimension parallel with direction of pour, as shown in the Drawings.

B. Lap joints 6 inches and seal vapor barrier joints with manufacturers' recommended mastic and pressure-sensitive tape.

C. After placement of vapor retarder, cover with sand cushion and compact to depth as shown on Drawings.

3.10 TOLERANCES:

A. Excavation for structures shall conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot except to facilitate drainage during construction stage.

B. Surface of subbase under structure slabs shall be graded smooth and even, free of voids, and rolled to required elevation. Provide final grades within a tolerance of 1/2 inch when tested with a 10-foot straightedge.

END OF SECTION 312334

SECTION 312500 - EROSION AND SEDIMENT CONTROL (NY)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY:

A. This Section includes erosion and sediment control measures. The Owner's Representative has the authority to limit the surface area of earth exposed by earthwork operations and to direct the Contractor to provide immediate temporary or permanent erosion or pollution control measures to minimize damage to property, dirt tracked onto roadways from vehicles, and contamination of watercourses and water impoundments.

B. The Contractor has the ultimate responsibility for providing adequate erosion control and water quality throughout the duration of the project. The Contractor shall provide all measures that may be needed to control erosion and water pollution.

C. In the event of a conflict between the Contract Plans, the reference standards herein, and the requirements laws, rules, or regulations of any other Federal, State, or local agency having jurisdiction, the more restrictive requirement shall apply.

D. This specification shall be utilized in conjunction with the Stormwater Pollution Prevention Plan (SWPPP) which has been prepared and is part of the Contract Documents.

1.3 RELATED SECTIONS:

A. The following sections contain related information:

1. Clearing and Grubbing – Section 311100
2. Rough Grading - Section 312213
3. Finish Grading – Section 312219
4. Dewatering – Section 312319
5. Topsoil Placement and Grading – Section 329119.13
6. Seeding – Section 329219

1.4 REFERENCE STANDARDS:

A. New York State Standards and Specifications for Erosion and Sediment Control Manual, latest edition.

B. New York State (NYS) Stormwater Management Design Manual, latest edition.

1.5 SUBMITTALS:

A. Erosion and Sediment Control Plan: Shall include methods of erosion control for the project in general, methods along haul roads and/or borrow pits, plans for disposal of waste material, and temporary stream crossing plans, as applicable.

B. Product Data: Provide catalog sheets or shop drawings for each type of product to be utilized as called for on the contract plans. Acceptable products for erosion control include, but are not limited to the following:

1. Compost Filter Sock.
2. Hay Bale.
3. Mulches.
4. Stream Protection.
5. Seed, Fertilizer.

1.6 QUALITY CONTROL:

A. Contractor shall retain the services of a certified E&SC inspector for construction storm water management inspections. The inspector shall have taken a 4-hour E&SC training course endorsed by the New York State Department of Environmental Conservation.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Products shall conform to the latest edition of the New York State Erosion and Sediment Control Manual. Only products allowed under this manual shall be approvable by the Engineer.

2.2 SOIL MATERIALS:

A. Mulches: Materials that meet minimum requirements published in Table 3.7 of the New York State Erosion and Sediment Control Manual. Anchoring material shall be Table 3.8 of the New York State Erosion and Sediment Control Manual.

B. Grasses: Seed mixture as specified in Division 32 Section “Seeding” or other species suitable for temporary cover that will not compete with the grasses sown later for permanent cover.

C. Jute Matting: Enkamat 7010 or approved equal.

2.3 COMPOST FILTER SOCK:

A. The compost filter sock shall be in accordance with the NYS Standards and Specifications for Erosion and Sediment Control (latest edition).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL:

A. Where applicable, installation of all erosion and sediment control devices shall be performed pursuant to the more restrictive of:

1. Manufacturer's written instructions.
2. Specifications as published in the New York State (NYS) Standards for Erosion and Sediment Control.
3. Specifications as published in Appendix C of the New York State (NYS) Stormwater Management Design Manual.

B. Installation of all erosion control devices shall occur prior to site disturbance to the maximum extent possible.

C. All temporary and permanent erosion and sediment control practices shall be maintained and repaired as needed to ensure continued performance of their intended function.

D. Owner will monitor Contractor's erosion control and work methods.

1. If the overall function and intent of erosion control is not being met, Owner will require Contractor to provide additional measures as required to obtain the desired results.
2. The erosion control features installed by Contractor shall be adequately maintained by Contractor until the project is accepted.

E. Working In or Crossing Watercourses and Wetlands:

1. Construction vehicles shall be kept out of watercourses to the extent possible.
   a. Where in-channel work is necessary, precautions shall be taken to stabilize the work area during construction to minimize erosion.
2. The channel (including bed and banks) shall always be re-stabilized immediately after in-channel work is completed.
3. Where a live (wet) watercourse must be crossed by construction vehicles during construction, a Temporary Stream Crossing in accordance with the latest NYS Erosion and Sediment Control Manual shall be provided for this purpose.

3.2 PROTECTION OF ADJACENT PROPERTIES:

A. Properties adjacent to the project site(s) shall be protected from loss of soil due to erosion as well as sediment deposition.

B. In addition to the erosion control measures required on the Contract Plans, perimeter controls may be required if damage to adjacent properties is likely, and may include, but is not limited to:

1. Sediment barriers such as straw bales, erosion logs, and compost filter sock.
2. Diversion swales.
3. Sediment basins.
4. Combination of above measures.

3.3 STABILIZED CONSTRUCTION ENTRANCE:

A. Stabilized construction entrances shall be provided at all construction site traffic entrance/exit points, outside of paved entrances or as specified in the *Standard Specifications For Stabilized Construction Entrance* included in the New York Guidelines for Urban Erosion and Sediment Control.

B. The stabilized construction entrances shall be provided prior to any activity on the site; maintained throughout construction and removed, and area restored, following construction.

C. The intent of the entrance is to prevent sediment from depositing upon Town, County, and State roadways. The Contractor's plans to enter and exit the construction site may require additional installations to achieve this goal. These will be provided as required to provide complete site access coverage, at no cost to the Owner.

3.4 MULCHES:

A. Ensure other erosion control measures are in place prior to mulching.

B. Slope and grade site to fit needs of selected mulch products.

C. Remove all undesirable stones and debris.

D. Install and anchor mulch according to Tables 3.7 and 3.8 of the New York State Erosion and Sediment Control Manual.

3.5 COMPOST FILTER SOCK AND HAYBALES:

A. Compost Filter Sock and haybales, as specified in the Standard Specifications included in the New York Guidelines for Urban Erosion and Sediment Control, shall be installed and maintained to control and prevent sediment movement. Required locations for silt socks and haybales shall include the following:

1. All down gradient areas of the site; to protect nearby watercourses and water supply wells.
2. Along paved areas to prevent sediment movement to the surface of the pavement.
3. All locations dictated by the Owner’s representative.

B. Compost Filter Sock and haybales shall be installed prior to site disturbance as required by the contract plans and the owner's representative.

C. Compost Filter Sock and haybales shall be maintained throughout the period of disturbance.

D. Compost Filter Sock and haybales shall be removed following establishment of sufficient vegetation for unpaved areas and after the period of disturbance for paved areas to control and prevent erosion.

3.6 SEDIMENT BASIN:

A. Sediment Basins, as shown or required, shall be as specified in the New York State Standards and Specifications for Erosion and Sediment Control Design Manual, shall be installed and maintained to control and prevent sediment movement.

3.7 DEWATERING ACTIVITIES SEDIMENT CONTROL:

A. All waters which the Contractor pumps from excavations on this project shall be routed through a portable sedimentation tank, filter bag or other acceptable practice, so as to remove all sediments carried by such water. The practice shall be in accordance with the Standard Specifications included in the New York Guidelines for Urban Erosion and Sediment Control. The practice(s) shall be provided at any and all locations along the trench route/excavation area, as warranted by dewatering activities. Dewatering activities shall conform to Specification 312319 "Dewatering."

3.8 DUST CONTROL:

A. Activities on this project may create dust from traffic and dry weather conditions. Dust control shall be provided to prevent dust throughout the project in accordance with the Standard Specifications for Dust Control included in the New York Erosion and Sediment Control Design Manual.

B. All pavement and sidewalks in all work areas shall be brush cleaned at the end of each working day to minimize dust potential.

3.9 SOIL RESTORATION:

A. Soil restoration is required where soils have been disturbed for development. Soil restoration is applied in the cleanup and landscaping phase followed by permanent vegetative ground cover. Soil restoration is to be performed in accordance with the NYSDEC Stormwater Management Design Manual Section 5.1.6 and as summarized in the following table:

Soil Restoration Requirements			
Type of Soil Disturbance	Soil Restoration Requirement		Comments/Examples
No soil disturbance	Restoration not permitted		Preservation of Natural Features
Minimal soil disturbance	Restoration not required		Clearing and grubbing
Areas where topsoil is stripped only - no change in grade	HSG A &B	HSG C&D	Protect area from any ongoing construction activities.
	apply 6 inches of topsoil	Aerate* and apply 6 inches of topsoil	
Areas of cut or fill	HSG A &B	HSG C & D	
	Aerate and apply 6 inches of topsoil	Apply full Soil Restoration **	
Heavy traffic areas on site (especially in a zone 5-25 feet around buildings but not within a 5 foot perimeter around foundation walls)	Apply full Soil Restoration (de-compaction and compost enhancement)		
Areas where Runoff Reduction and/or Infiltration practices are applied	Restoration not required, but may be applied to enhance the reduction specified for appropriate practices.		Keep construction equipment from crossing these areas. To protect newly installed practice from any ongoing construction activities construct a single phase operation sock area
Redevelopment projects	Soil Restoration is required on redevelopment projects in areas where existing impervious area will be converted to pervious area.		

*Aeration includes the use of machines such as tractor-drawn implements with coulters making a narrow slit in the soil, a roller with many spikes making indentations in the soil, or prongs which function like a mini-subsoiler.
** Per “Deep Ripping and De-compaction, DEC 2008”.

3.10 SURFACE RESTORATION:

A. Areas that are disturbed as a result of this project shall be restored. This cover shall consist of grasses or other landscaping pursuant to these specifications.

3.11 EROSION CONTROL DEVICE REMOVAL:

A. Removal of any and all devices used for the purposes of preventing soil runoff shall be removed after suitable vegetation has stabilized the soil.

3.12 CONTRACTOR SITE INSPECTIONS:

A. Inspection Protocol: The Contractor is responsible for conducting and documenting inspections of the construction site(s) once every 7 calendar days and within 24 hours after a rainfall event of

0.5 inch or greater or equivalent snowfall.

B. Inspection Documentation: Use the inspection checklists in Appendix G of the NYS Stormwater Management Manual, latest edition. All inspection checklists shall be turned over to the Owner upon completion of the project.

END OF SECTION 312500

SECTION 321000 - ASPHALT CONCRETE ROADWAY CONSTRUCTION (NY)

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Under this item, the Contractor shall perform all work as necessary for the preparation of the roadway as shown on the drawings, called for in the Specifications or as required based on the site conditions. The work shall include, but may not be limited to; subgrade preparation; subbase placement; milling, shaping and removal of portions of existing surfaces; placement of all asphalt concrete pavement courses; and other associated miscellaneous work.

B. Pavement courses shall be hot, plant-mixed asphalt concrete on a prepared base in accordance with these specifications and in reasonable close conformity with the required lines, grades, thickness and typical sections shown on the plans, at the locations shown on the plans.

C. It is the intent of these specifications to obtain a complete and satisfactory roadway structure suitable for urban arterial light industrial use.

D. Generally, asphalt concrete roadway construction will include three (3) pavement courses, base, binder and top. Where the plans call for a two course roadway construction, such roadway will be constructed utilizing a binder and top course, unless specifically noted otherwise. With either roadway configuration, work and materials shall comply with the requirements noted herein, as called for on the plans, and as required by the applicable N.Y.S.D.O.T. Standards.

E. Where applicable, this section shall apply to parking lot and other similar construction, as depicted on the plans.

1.2 EXISTING CONDITIONS:

A. It shall be the Contractor's responsibility to visit the entire project site and investigate all conditions that may affect his work.

B. The Contractor shall take all necessary as-built measurements and make all necessary investigations in the field, prior to layout of the proposed installation of the work.

1.3 QUALITY ASSURANCE:

A. These specifications are to be supplemented by the "Standard Specifications: Construction and Materials" (latest revision) as published by the Office of Engineering, New York State Department of Transportation. All provisions contained in those specifications, relative to quality of construction and materials and execution of the work shall be deemed part of these specifications.

B. The quality of all types of work produced shall be that which can be truly classified as good standard practice in the trade for each respective type of kind of work.

1.4 SUBMITTALS REQUIRED:

A. The Contractor shall not deliver nor place any materials, until such time that each material used in the work has been submitted and accepted by the Engineer.

B. Six (6) complete sets of Shop Drawings shall be submitted to the Engineer. The Shop Drawings shall bear the Contractor's stamp of approval indicating that he has reviewed the contents, and that same complies with the Contract requirements.

C. Shop Drawing submittals shall conform to the requirements of Section 7.16 of the General Conditions.

PART 2 - MATERIALS

2.1 MATERIAL REQUIREMENTS (GENERAL):

A. Subbase (As Required): Subbase course material will comply with Standard Specifications for Construction Materials, New York State Department of Transportation, Item 304 "Subbase Course" Types 1, 2 or 4 and Technical Specification 02609. The Contractor shall have the subbase material tested for compliance to the Specification requirements and submit the test results to the Engineer for acceptance, at no additional cost to the Owner.

B. Asphalt Concrete: Asphalt concrete materials will comply with Standard Specifications for Construction and Materials, New York State Department of Transportation, Section 403.

C. Tack Coat: Shall comply with Standard Specifications for Construction and Materials, New York State Department of Transportation, Section 407.

2.2 BITUMINOUS TACK COAT:

A. The bituminous tack coat shall meet the following requirements:

1. Comply with NYSDOT Material Designation 702-90.
2. Shall be an asphalt emulsion tack coat produced by diluting bituminous materials with a suitable emulsifier solution.

B. Tack coat shall not be applied unless the spraying temperature is within the suggested range of 75o F - 150o F.

C. The tack coat shall be sampled and tested in a manner acceptable to the Engineer, at no additional cost to the Owner.

2.3 HOT MIX ASPHALT CONCRETE PAVEMENT:

A. All asphalt concrete shall be plant-mixed asphalt concrete prepared in accordance with these Specifications and the related and referenced texts.

B. Binder and top pavements shall be rut avoidance type asphalt concrete.

C. The materials and composition for the mixtures utilized shall meet the requirements for Type 1 base course, Type 3 binder course and Type 6F top course.

D. Unless otherwise called for, base course pavements shall be Type 1 dense base course having an asphalt content of 4.0 - 6.0%. Composition of Type 1 base course (or Type 2, if so called for), shall comply with Table 401-1 of the NYSDOT Standard Specifications.

E. Binder course pavement shall be Type 3 rut avoidance type. Materials and composition for the mixture shall meet the requirements noted in Subsection 401-2.01 through 401-2.05 of the NYSDOT Standard Specifications, except as modified herein.

F. Binder course shall meet the following requirements, except that production tolerance will be permitted to exceed the design general limits, where accepted by the Engineer:

Screen Size	% Passing	Production Tolerance (%)
1-1/2"	100	-
1"	95-100	-
1/2"	58-73	+/- 5
1/4"	38-53	+/- 5
1/8"	26-40	+/- 4
20	9-23	+/- 4
40	4-18	+/- 4
80	3-13	+/- 3
200	2-6	+/- 2
Asphalt Content (%)	4.0-6.0	

G. Top course shall be Type 6F rut avoidance type and shall meet the following requirements:

Screen Size	% Passing	Production Tolerance (%)
1-1/2"	-	-
1"	100	-
1/2"	95-100	-
1/4"	65-85	+/- 5
1/8"	36-65	+/- 4
20	15-39	+/- 4
40	8-27	+/- 4
80	4-16	+/- 3
200	2-6	+/- 2
Asphalt Content (%)	5.4-6.6	

H. Coarse aggregates for binder and top rut avoidance pavements shall be from NYSDOT approved sources and shall meet the high friction requirements. Screened gravel shall not be permitted unless specifically approved. Wappinger Dolomite (as defined by NYSDOT) shall not be permitted. For the Type 6FRA top mix, not less than 20% (by weight) of the total coarse aggregate particles (plus 1/8" material) shall be non-carbonate (as defined by NYSDOT). The coarse aggregates shall be proportioned and blended to provide a uniform mixture.

I. Mix Properties - The mixtures shall meet the marshall property criteria as follows:

Mix Property	Type 3RA	Type 6FRA
Stability, lb., min.	1500	1500
Flow, .01 in., min.	8	8
Marshall Quotient, lb/.01 in., min.	150	150
Air Voids, Percent	3.0-5.0	3.0-5.0
Voids in Mineral Agg. (VMA), Percent min.	13.5	15.5

The Marshall specimens shall be prepared, mix properties determined, and completed mix design submitted in accordance with the standard procedures outlined by the N.Y.S.D.O.T. with the following modifications:

1. Compactive effort shall be 75 blows per side.

J. Five point asphalt cement content Marshall design is required prior to production. One point designs are not acceptable.

K. The minimum specified VMA shall be met at each of the five mix design asphalt cement contents.

L. The marshall quotient is calculated as the corresponding ratio of corrected stability (lbs.) to flow (.01 in.).

M. The optimum asphalt cement content shall be determined by the "Range" method. Graphs shall be constructed for each of the specified mix design properties (stability, Marshall quotient, air voids, and VMA) using each property as the vertical axis and percent asphalt cement content as the horizontal axis. The plotted values in each graph shall be fitted with a smooth curve that obtains the "best fit" for all values. A vertical line is drawn at the point where the asphalt cement content provides the acceptable lower and upper limits for the properties of stability, flow, Marshall quotient, and air voids. The mid-point of the common overlap is the optimum asphalt cement content provided it does not fall on the positive slope of the VMA curve. When this occurs, the low point of the VMA curve shall be the optimum asphalt cement content provided it falls within the common overlap of the specified stability, flow, Marshall quotient, and air voids ranges.

N. Truing and Leveling Course - Where a truing and leveling course is called for, shown or is required based on the conditions, the work shall include placing a course of minimum variable thickness of proper plant mix necessary to bring the surface of the existing pavement to the same transverse slope and longitudinal grade required for the finished pavement course.

O. The work shall consist of removing irregularities in the old pavement, filling and patching holes, correcting variations in banked pavement, establishing pavement crowns, etc. All depressions and wheel path ruts shall be filled prior to the paving of the truing and leveling course.

P. Asphalt pavement utilized for the truing and leveling course shall be as follows, unless otherwise called for on the drawings:

Compacted Thickness	Type Asphalt Concrete
Up to 1-1/2"	Top - Type 6F(RA)
1-1/2" to 4"	Binder - Type 3(RA)
4" and Greater	Base - Type 1

Q. Special attention shall be paid to the proper compaction of thin sections. The surface of this course shall be tested in the same manner prescribed in N.Y.S.D.O.T. Standard Specification paragraph 401-3.14, except that the allowable variation from the true surface after compaction shall not exceed 3/8 inch.

PART 3 - CONSTRUCTION DETAILS

3.1 GENERAL:

A. Prior to placement of any subbase the subgrade shall be proofrolled as follows:

3.2 EQUIPMENT:

A. The proof roller shall consist of a chariot type rigid steel frame with a box body filled with proofrolling ballast thirty (30) tons gross weight, and mounted on four (4) pneumatic tired wheels acting in a single line across the width of the roller on its transverse load center line. The wheels shall be equipped with 18.00 x 24, or 18.00 x 25,24 ply tires, and shall be suspended on articulated axles such that all wheels carry approximately equal loads when operating over uneven surfaces.

B. Two complete passes of the roller shall be applied over all elements of the area to be proof rolled. Any deficiencies disclosed during the proof rolling operation shall be corrected. Subsidence depressions shall be filled with material similar to the subgrade soil and then compacted in a normal manner. After compaction, these areas shall be proof rolled again. Corrective work shall be judged complete when all elements of the subgrade surface over a given embankment show a satisfactory uniform response to the proof roller, acceptable to the Engineer.

C. The Contractor may propose alternate methods for proofrolling. Any such alternate methods must be as acceptable to the Engineer. The Engineer and Owner reserve the right to require proofrolling in accordance with the provisions noted above, even following the completion of the alternate test method, solely at the Engineer's discretion.

3.3 SUBBASE COURSE:

A. Contractor shall lay a foundation course of a compacted depth as shown on the drawings. The laying of this course shall not be allowed if there is any indication of rain, if the ground is wet or will knead under the loaded truck wheels or if there is frost in the ground.

B. In laying the subbase, care is to be exercised to see that it is uniformly spread. After it is leveled and rolled until it does not wave, creep or sag under a ten (10) ton roller, the surface is to be carefully checked to see that the full thickness is laid and to assure that the surface is to grade for the asphaltic concrete pavement. The tolerance for the final grade of the subbase is +/- 1/4".

3.4 WEATHER AND SEASONAL LIMITATIONS:

A. Bituminous plant mix shall not be placed on any wet surface or when the surface temperature is less than specified in "Temperature and Seasonal Requirements" or when weather conditions otherwise prevent proper handling or finishing of bituminous mixtures as determined by the Engineer. Top course mixes shall be paved within the seasonal limitations indicated in "Temperature and Seasonal Requirements".

B. Surface temperatures shall, in all cases, be the controlling temperatures at which material is placed. Paving shall be discontinued as soon as the temperature falls below the requirements.

C. The base and binder course shall be covered with a surface (top) course prior to the end of the paving season. If this cannot be accomplished by the Contractor, he shall be solely responsible for any damage to the subbase, base or binder courses. Repairs made to the damaged areas shall be acceptable to the Engineer.

D. Bituminous paving mixtures for driveways, sidewalks, gutters and other incidental construction shall be placed on surfaces having a temperature of 45 degrees Fahrenheit or greater, unless otherwise accepted by the Engineer.

TEMPERATURE AND SEASONAL REQUIREMENTS

Nominal Compacted Lift Thickness	Surface Temperature Minimum (Note 1)	Seasonal Limits
3" or greater	40 degrees Fahrenheit	None
Greater than 1" but less than 3"	45 degrees Fahrenheit	May 1 to Oct.15
1" or less	50 degrees Fahrenheit	May 1 to Oct.15

Note 1: All temperatures shall be measured on the surface where the asphalt is to be placed and the controlling temperature shall be the average of three temperature readings taken at locations +/- 25 feet apart.

3.5 COLD MILLING OF EXISTING SURFACES:

A. Where called for or otherwise required, the work shall include the milling, shaping and removal of portions of existing surfaces by a cold milling process, and subsequent cleaning, utilizing equipment and procedures meeting the requirements of this specification.

B. The work shall include milling of bituminous or portland cement concrete as shown or called for.

C. Milling machines shall be power operated, self-propelled machines capable of removing the desired thickness of existing surfaces. The machines shall have sufficient power, traction and stability to accurately maintain depth of cut and slope. They shall be capable of producing a finished profile and cross slope to within 1/4 inch of that required and shall produce a uniform surface texture free from gouges and ridges greater than 3/8 inch in depth.

D. The machines shall be equipped with a means to control dust and other particulate matter created by the cutting action. The machines shall have an integral loading system or sufficient equipment shall be provided to accomplish complete removal of milled material at a rate equivalent to the milling rate.

E. Vacuum trucks, street sweepers or power brooms shall be used to clean the milled surfaces. The Engineer may disallow the use of power brooms in urban, residential or other sensitive areas if he deems the dust raised by the broom to be objectionable.

F. All milled material, including that removed by other means, shall be immediately removed from the

milled surfaces and adjacent surfaces. When working adjacent to traffic, the Contractor shall immediately remove material that is spilled on the traveled way. Surfaces shall be cleaned of all fines and dust prior to opening to traffic. The Contractor shall conduct his operations in such a manner that dust is controlled and is not objectionable. Milled and adjacent surfaces shall be cleaned again, as directed by the Engineer, prior to the placement of tack coats, or pavement courses if traffic has been allowed on the milled surface and/or if more than 48 hours have elapsed since the initial cleaning. Material removed during the milling process, including foreign debris within or on the pavement, shall become the property of the Contractor and shall be disposed of at a site obtained by the Contractor.

G. Unless otherwise indicated on the plans, profile and cross slope shall be controlled by a taut reference string line. The reference elevation and string line shall be established by the Contractor and subject to the acceptance of the Engineer.

H. Areas not accessible to the milling machine, such as around and/or adjacent to inlets, manholes, curbs and transverse joints on structures, may be removed by a small milling machine, handwork or other methods acceptable to the Engineer.

I. Milled longitudinal or transverse vertical faces exceeding 1-1/4 inches in height that would be exposed to traffic during non-work hours shall be sloped or tapered in a manner so as not to create a traffic hazard. Milling operations shall be conducted to preclude the possibility of pavement runoff collecting along milled joints and creating a traffic hazard. The Contractor shall maintain drainage at catch basins.

J. Milled surfaces to be overlayed with asphalt concrete shall be covered with at least a single course of asphalt concrete before the end of the paving season. Portland cement concrete overlays shall be completed over milled surfaces before the end of the paving season. Damage to milled surfaces resulting from traffic or other causes such as, but not limited to, raveling, fuel spillage or any contaminants which would inhibit bond, shall be repaired or remilled by the Contractor to the satisfaction of the Engineer.

3.6 HAULING EQUIPMENT:

A. The mixture shall be transported from mixing plants to the work site in tight vehicles having clean and smooth metal beds. Each load shall be covered with canvas or other suitable material of such size as to protect the mixture from the weather. When necessary, so that the mixture will be delivered on the road at the specified temperatures, truck bodies shall be properly insulated.

B. The inside surface of the vehicles used for the transportation of plant mixes shall be lightly coated, just before the vehicles are loaded, with either a whitewash of lime and water, soap solutions or detergents.

C. After application, the truck bodies shall be raised for a sufficient time to allow the excess fluid to drain.

3.7 PREPARATION OF EXISTING PAVEMENT:

A. Existing pavement and shoulder surfaces to be overlaid, including ruts and depressions, shall be cleaned by the use of mechanical sweepers, hand brooms, or other effective means until the surfaces

are free of all material which might interfere with the bond between the overlay material and the existing surfaces. All cleaning equipment shall be accepted by the Engineer prior to use. Cleaning shall continue until adequate cleaning results, as acceptable to the Engineer.

B. All debris shall be removed from the pavement and shoulders surfaces and disposed of in a manner acceptable to the Engineer. The pavement and shoulders shall be kept clean until the overlay operations are completed. Cleaning of shoulders is required only when the shoulder surface is constructed of Portland Cement, asphalt concrete or a surface treatment thereon.

C. All unsealed and inadequately sealed joints and cracks, in the opinion of the Engineer, shall be subjected to a compressed air stream of at least 80 p.s.i.g. measured at the source. Joints and cracks in the pavement as identified by the Engineer, shall be cleaned of all dirt and loose material holding the cleaning jet 1 inch above the pavement surface. Old joint and crack sealer remaining after such cleaning operation need not be removed. The cracks shall be kept clean until the sealing, filling and paving operations are completed. Joints and cracks in the existing pavement from 1/4 inch to 1 inch wide shall be sealed with a bituminous material meeting the requirements of Asphalt Filler in the N.Y.S.D.O.T. Standard Specifications. To ensure that space will be available for expansion of the asphalt when the hot bituminous mixture is paved over the joint or crack, the joint or crack shall not be filled completely to the surface. Blotting with fine aggregate shall be provided if, in the opinion of the Engineer, same is necessary to prevent tracking the bituminous material over the pavement surface.

3.8 Joints and cracks greater than 1 inch wide shall be filled with asphalt concrete meeting the requirements of Section 401 of the N.Y.S.D.O.T. Standard Specifications. Alternate materials may be used subject to the acceptance of the Engineer. Joints and cracks less than 1/4 inch will not be required to be cleaned or sealed.

3.9 Work on joints and cracks shall not begin until all stress relieving pavement repairs have been completed.

3.10 TACK COAT:

A. For all areas where existing bituminous or portland cement concrete surfaces are called for to be properly prepared, or where new pavement courses are to be placed over such existing surfaces, the work shall include application of a bituminous tack coat in accordance with these specifications.

B. Bituminous tack coat shall comply with requirements for "Asphalt Emulsion for Tack Coat", Section 702-90, of the N.Y.S.D.O.T. Standard Specifications.

C. The Contractor shall provide a distributor for applying the tack coat. The distributor shall be designed, equipped, maintained and operated so that the tack coat can be heated and applied uniformly on variable widths of surface up to 15 feet at readily determined and controlled rates from 0.03 to 2.0 gallons per square yard, with uniform pressure, and with an allowable variation from any specified rate not to exceed 0.02 gallons per square yard. Distributor equipment shall include a tachometer, accurate metering device or a calibrated tank, and a thermometer for measuring temperatures of tank contents. Distributors shall be equipped with a power unit for the pump, and full circulation spray bars adjustable laterally and vertically.

D. The tack coat shall be uniformly applied by a pressure distributor to a prepared clean pavement. The tack coat shall be applied to cause the least inconvenience to traffic and to permit one-way traffic,

where practical, to prevent pickup or tracking of the bituminous material.

E. Tack coat shall not be applied on a wet pavement surface or when the surface temperature is below 45o F. The temperature and areas to be treated shall be accepted by the Engineer prior to application. The application rate shall be 0.05 gallons per square yard (minimum), or as otherwise accepted by the Engineer.

3.11 BITUMINOUS PAVERS:

A. Bituminous pavers shall be self-powered with an activated screed or strike-off assembly. The machine shall be capable of spreading and finishing courses of bituminous plant mix material in lane widths applicable to the specified typical section and thicknesses shown on the plans. Pavers used for shoulders and similar construction shall be capable of spreading and finishing courses of bituminous plant material in widths shown on the plans. The paver shall have a receiving hopper with sufficient capacity for uniform spreading operation and with automatic flow controls to place the mixture uniformly in front of the screed. The screed or strike-off assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving or gouging the mixture. When laying mixtures, the paver shall be capable of operating at forward speeds consistent with satisfactory placement of the mixtures.

B. All bituminous pavers, used to place base, binder and surface courses shall be equipped with automatic transverse slope and longitudinal grade screed controls. The controls shall automatically adjust the screed and increase or decrease the mat thickness to compensate for irregularities that are in the surface being paved. The controls shall be capable of maintaining the proper transverse slope and be readily adjustable so transitions and super elevated curves can be satisfactorily paved. The controls shall operate from suitable fixed or moving references as prescribed in "Spreading and Finishing", hereinafter. Widths in excess of seventeen (17) feet shall have approved automatic transverse slope and longitudinal grade screed controls that operate from references on both sides of the paver.

C. The transverse slope and longitudinal grade screed controls of the bituminous paver may be manually adjusted, where acceptable to the Engineer, according to the requirements of "Spreading and Finishing" hereinafter. Any paver in the sole opinion of the Engineer to be found worn or defective at any time shall immediately be prohibited from use on the project until such time as repairs have been made to the satisfaction of the Engineer and at no additional cost to the Owner.

3.12 ROLLERS:

A. Rollers shall be either a vibratory or static steel wheel or pneumatic tire type in good mechanical condition free from excessive backlash and capable of operating at speeds slow enough to avoid displacement of the bituminous mixture. The number and weight of rollers shall be sufficient to satisfactorily compact the mixture while it is still in a working condition. The use of equipment which results in excessive crushing of aggregate will not be permitted.

B. Vibratory rollers shall be on the current NYSDOT approved list - Bituminous Concrete Vibratory Compaction Equipment. The use of vibratory compaction equipment shall be at the Contractor's own risk. The Contractor shall be fully responsible for the cost of repairing all damages which may occur to highway components and adjacent property caused by vibratory equipment.

C. Steel rollers shall be self-propelled and be either of the 10-12 ton tandem three-axle type, or 8-10 ton tandem two-axle type.

D. Pneumatic rubber-tired rollers shall be self-propelled and consist of two axles on which are mounted multiple pneumatic-tired wheels in such a manner that the rear wheels will not follow in the tracks of the forward wheels and will be spaced to give essentially uniform coverage with each pass. The axles shall be mounted in a rigid frame provided with means for adding ballast. Wheels shall be so mounted as to oscillate individually or in pairs. The tires shall be smooth and show no tread pattern, be of equal size and diameter, and be uniformly inflated. Pneumatic rollers shall not be utilized for compaction of the top course of pavement either vibratory or static steel wheel roller must be used. Pneumatic rollers shall meet the following requirements:

Maximum Wheel Load	5,600 pounds
Tire Compression on Pavement	80 p.s.i. +/- 5 p.s.i.
Maximum Axle Load	22,400 pounds

Alternate types of rollers may be acceptable to the Engineer, if field tests or other data demonstrates that satisfactory results can be achieved.

3.13 SPREADING AND FINISHING:

A. Base and binder course material may be delivered from more than one plant provided that no placing or compaction difficulties are evident to the Engineer. The delivery of top course material from two or more plants, in alternate deliveries to the same spreader, will not be permitted unless both the same aggregate source and job mix formula are used by all plants.

B. The mixture shall be laid upon an acceptable clean, dry surface, spread and struck off to the established grade and elevation. Acceptable bituminous pavers shall be used to distribute the mixture either over the entire width or over such partial width as may be practicable. Bituminous pavers shall be in the charge of an experienced operator. Placing of the mixture shall be continuous at a desired rate of not less than fifty (50) tons per hour. The Engineer may permit a lesser rate, if satisfactory results are achieved. Upon arrival at the site, the mixture shall be dumped into the paver and immediately spread and struck off to the width required and to such appropriate loose depth that when the work is completed, the required compacted thickness of mixture will be obtained. The depth of any one course of plant mixed material shall not be greater than that necessary to produce a compacted thickness of four (4) inches.

C. For the initial pavement course laid with automatic bituminous pavers, the paver shall be guided by a taut reference line positioned at or near the pavement centerline or edge. The reference line shall be supported at approximately twenty-five (25) feet intervals on tangent sections and at closer intervals on curves. The line shall be tensioned sufficiently to remove any sags.

D. The Contractor shall erect and maintain the reference line to the satisfaction of the Engineer. A moving reference of at least thirty (30) feet in length, such as a floating beam, ski, or other suitable type may be substituted for the reference line if the surface to be paved is sufficiently even and satisfactory results can be achieved. A short ski or shoe may also be used for the initial course, if a satisfactory fixed reference, such as a curb, gutter or other fixed reference, is adjacent to the pavement.

E. Subsequent pavement courses placed over the initial course can be placed using a suitable fixed

reference or by a moving reference having a minimum length of thirty (30) feet. Any course in an adjacent lane may be used as a reference line for a short ski, or other similar device.

F. The automatic screed controls will not be required where existing grades at roadway intersections or drainage structures must be met, for shoulders, temporary detours, behind curbs, or in other areas where its use is impractical as determined by the Engineer.

G. If the areas to be paved are small and scattered, a paver may be dispensed with and the course spread by hand methods as acceptable to the Engineer. For such areas, the mixture shall be dumped, spread and screeded to give the required section and compacted thickness.

H. Before any rolling is started, the loose mat shall be checked, any irregularities adjusted, and all unsatisfactory material shall be removed and replaced.

3.14 COMPACTION:

A. Immediately after the bituminous mixture has been spread, struck off and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling. The surface shall be rolled when the mixture is in the proper condition and when the rolling does not cause undue displacement, cracking or shoving.

B. During the initial rolling, a static roller with a minimum weight of 8 tons shall travel parallel to the center line of the pavement beginning at each edge and working toward the center, overlapping on successive trips by one half the width of the roller. Banked curves shall be rolled starting at the low side edge and working toward the superelevated edge.

C. Rollers shall move at a slow and uniform speed, not exceeding 2.5 miles per hour. The roller drive roll or wheel shall be nearest the paver.

D. Any displacement occurring as a result of reversing the direction of a roller, or from other causes, shall be corrected at once by the use of rakes and addition of fresh mixture where required. Care shall be exercised in rolling not to displace the line and grade of the edges of the bituminous mixture. To prevent adhesion of the mixture to the rollers, the wheels shall be kept properly moistened with water or water mixed with small quantities of detergent. In no case shall a solvent having affect upon bituminous material be used.

E. The Contractor shall provide a combination of the rollers and utilize one of the options in Section 401-3.12 of the NYSDOT Standard Specifications.

F. Along forms, curbs, headers, walls and other areas not accessible to the rollers, the mixture shall be thoroughly compacted with mechanical tampers as accepted by the Engineer. On depressed areas, a trench roller may be used or cleated compression strips may be used under the roller to transmit compression to the depressed area.

G. Suitable means shall be provided to keep the pavers, other equipment and tools free from bituminous accumulations. The surface of the pavement shall be protected from drippings of oil, kerosene, or other materials used in paving, and cleaning operations.

H. The Contractor may be required to adjust and change both equipment and compaction procedure if in the sole opinion of the Engineer insufficient compaction is being achieved.

I. Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective shall be removed and replaced with fresh hot mixture, which shall be compacted to conform with the surrounding area. Any area showing an excess or deficiency of the bituminous material shall be corrected to the satisfaction of the Engineer. If, in the sole opinion of the Engineer, an unsatisfactory area that develops during the life of the contract, the area shall be removed and replaced with suitable material at the expense of the Contractor.

3.15 CONDITIONING OF EXISTING SURFACE:

A. The surface of the existing pavement shall be cleaned, joints and cracks filled, and the surface leveled to a uniform grade and cross slope in all areas prior to the application of a new bituminous concrete course. The surface shall be cleaned and the joints and cracks filled to the satisfaction of the Engineer. The expense for cleaning foreign material from the pavement shall be borne by the Contractor. Leveling of the surface shall be in conformance with the requirements stated below.

B. Contact surfaces between bituminous mixtures and Portland Cement concrete such as adjacent pavement, edges, existing pavement, curbing, gutters, manholes and other structures shall be painted with a thin, uniform coating of bituminous material prior to the bituminous mixture being placed against them.

3.16 JOINTS:

A. The finished pavement at joints shall comply with surface smoothness requirements and exhibit the same uniformity of texture and compaction as other sections of the course. Rollers shall not pass over the unprotected edges of a freshly laid mixture.

B. In the formation of all joints, the exposed edge of the existing layer that will become part of the joint shall be the full thickness of the layer and straight. If the existing edge is unacceptable to the Engineer, the edge shall be corrected by using a power driven saw or other acceptable tools to cut a neat line at the expense of the contractor. A light coat of bituminous material shall be applied to existing pavement edges in order to provide bond with the newly laid pavement.

C. Transverse - The placing of the course shall be as continuous as possible. The joint shall be formed by cutting back on the previous run to expose the full depth of the course.

D. Longitudinal - Longitudinal joints in the surface course shall correspond with the edges of proposed traffic lanes unless otherwise accepted by the Engineer. When traffic is maintained on the roadway during paving operations, the mixture shall be laid such that no more than 100 feet of pavement edge will be exposed at the end of the working day. The Engineer may permit an exposed edge of this type in excess of 100 feet providing that the edge is adequately protected against damage by vehicles and equipment.

3.17 SURFACE TOLERANCE:

A. The pavement surface shall be tested in the presence of the Engineer with a sixteen (16) foot straight-edge or string line placed parallel to the centerline of pavement and with a ten (10) foot straight-edge or string line placed transversely to the centerline of pavement on any portion of the pavement surface. Variations exceeding 1/4" shall be satisfactorily corrected or the pavement relaid at no additional cost to the Owner. The Contractor shall supply the materials and labor as necessary

to perform this test in the presence of the Engineer at no additional cost.

3.18 THICKNESS TOLERANCES:

A. The thickness indicated for each of the various courses of bituminous pavement is the nominal thickness. The pavement shall be so constructed that the final compacted thickness is as near to the nominal thickness as is practical and within the tolerances specified below.

B. Cores shall be performed at a minimum of every 350 feet in a location selected by the Engineer.

C. Determinations for final acceptance and pavement will be made from cores or thickness measurements taken on the completed pavement. The Contractor shall fill all core holes with bituminous concrete and compact the mixture in a manner acceptable to the Engineer. The cost of all testing and associated work shall be at the Contractor's expense.

D. A tolerance not to exceed minus (-) 1/4" from nominal thickness required for the course specified will be acceptable where the required nominal thickness is four (4) inches or less. A tolerance not to exceed minus (-) 1/2" from the nominal thickness required for the course or courses specified will be acceptable where the required nominal thickness is over four (4) inches. In addition, the sum total thickness of all bituminous mixture courses shall not vary from the total of the nominal thickness indicated on the plans by more than minus (-) 1/4" where the total nominal thickness is eight (8) inches or less; or more than minus (-) 1/2" where the total nominal thickness is more than eight (8) inches.

E. No payment will be made for any extra thickness placed over and above the permissible tolerance.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT:

A. The unit of measurement shall be the square yards of roadway constructed. Payment will be made for the number of square yards of roadway constructed at the unit price under the appropriate item in the proposal. These prices shall include furnishing of all materials, removal of existing pavement and excavation of all materials to the subgrade, subbase placement, cold milling, cleaning of all pavement surfaces prior to pavement application, tack coat, asphalt concrete placement, compaction required and all work incidental thereto, including the necessary testing, complete.

4.2 PAVEMENT:

A. Pavement placement shall be made and paid for under this item only for those sections contained within the payment limits shown on the contract plans. All pavement, which is disturbed by the Contractor due to his operations, other than where shown on the plans or indicated in writing by the Engineer, shall be replaced in accordance with these specifications at the Contractor's expense.

END OF SECTION 321000

SECTION 323100 – HEAVY DUTY CANTILEVER SLIDE GATE SYSTEM (CHAIN LINK)

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The work in this section shall include furnishing all labor, materials, equipment and appliances necessary to complete all Fortress TYM-SL-2000DC Heavy Duty Gate System(s) required for this project in strict accordance with this specification section and drawings. The gate and operator shall be specifically designed to complement each other as a system and be provided by a single manufacturer. Components (operator from one source and gate panel from another) assembled at the job site to form a system will not be approved.

1.2 REFERENCES

A. UL 325 Gate Operator Requirements. See 2.1 D.

1. Automated / operated vehicular gates are not to be used for pedestrian traffic. Separate pedestrian gates must always be provided if pedestrian traffic is expected.

B. ASTM F2200 – Standard Specification for Automated Vehicular Gate Construction. See 2.1 D.

C. ASTM F 1184 – Standard Specification for Industrial and Commercial Horizontal Slide Gates, Type II, Class 2. See 3.2 B.

D. American Welding Society AWS D1.2 Structural Welding Code. See 2.1 C.

E. American Society of Civil Engineers – ASCE-7 – Minimum Design Loads and Associated Criteria for Buildings and Other Structures. See 1.3 C (i).

1.3 SUBMITTAL

A. Product Data:

1. Provide manufacturer’s catalog cuts with printed specifications and installation instructions.

2. Deliver two copies of operation and maintenance data covering the installed products. Manual to include parts list showing manufacturer’s names and part numbers for the gate operator.

B. Shop Drawings:

1. Supply shop drawings showing the relationship of operating systems with gate components, including details of all major components.

2. Include complete details of gate construction, gate height and post spacing dimensions.

C. Certification of Performance Criteria:

1. Manufacturer of gate system shall provide certification stating the gate system includes the following material components that provide superior performance and longevity. Alternate designs built to minimum standards that do not include these additional structural features shall not be accepted.

   a. Gate track system shall be keyed to interlock into gate frame member (providing 200% additional strength when compared to weld only keyless systems). When interlocked with and welded to the "keyed" frame top member, gate track forms a composite structure.

   b. Gate shall have a minimum counterbalance length of 50% opening width which provides a 36% increase in lateral resistance (when compared to ASTM minimum of 40% counterbalance). If gate is ever to be automated, counterbalance section shall be filled with fabric or other specified material.

   c. To provide superior structural integrity, intermediate vertical members shall be used – with spacing between verticals to be less than 50% to the gate frame height.

   d. Entire gate frame (including counterbalance section) shall include 2 adjustable stainless or galvanized steel cables (minimum 3/16") per bay to allow complete gate frame adjustment (maintaining strongest structural square and level orientation).

   e. Gate truck assemblies shall be tested for contiguous duty and shall have precision ground and hardened components. Bearings shall be pre-lubricated and contain shock resistant outer races and captured seals.

   f. Gate truck assemblies shall be supported by a minimum 5/8" plated steel bolt with self aligning capability, rated to support a 2,000 # reaction load.

   g. Hanger brackets shall be hot dipped galvanized steel with a minimum 3/8" thickness that is also gusseted for additional strength.

   h. Gate top track and supporting hangar bracket assemblies shall be certified by a licensed professional engineer to withstand a 2,000 lb. vertical reaction load without exceeding allowable stresses.

   i. Gate is designed to meet specified ASCE-7 wind load requirements with the gate in the closed and latched condition only. Typical gate design is expected to operate satisfactorily in winds up to 30 MPH. Depending on gate panel infill, winds higher than 30 MPH may cause gate operational problems (if automated, operator entrapment may trigger; gate panel may not engage receiver). For sites with higher operational, non-typical, or specified wind loadings, manufacturer should be advised of the site conditions and a specifically engineered design will be offered.

D. Certifications:

1. Gate in compliance with ASTM F 2200, Standard Specification for Automated Vehicular Gate Construction per section 1.2 B.

2. The gate operator shall be in compliance with UL 325 as evidenced by UL listing label attached to gate operator. See 1.2 A

3. Gate manufacturer shall provide independent certification as to the use of a documented Welding Procedure Specification and Procedure Qualification Record to insure conformance to the AWS D1.2 welding code. Upon request, Individual Certificates of Welder Qualification documenting successful completion of the requirements of the AWS D1.2 code shall also be provided. See 1.2 D.

4. Manufacturer shall supply gate design performance certification as per Section 1.03 C.

5. Gate is to be designed to meet specified ASCE-7 wind load requirements with the gate in the closed and latched condition only. Typical gate design is expected to operate satisfactorily in winds up to 30 MPH. Depending on gate panel infill, winds higher than 30 MPH may cause gate operational problems (operator entrapment sensing may trigger; gate panel may not engage receiver). For sites with higher operational, non-typical, or specified wind loadings, manufacturer should be advised of the site conditions and specifically engineered design will be offered.

PART 2 - PRODUCTS

2.1 CANTILEVER SLIDE GATE SYSTEM MANUFACTURERS

A. The cantilever sliding gate system shall be manufactured by Tymetal Corp., 678 Wilbur Avenue, Greenwich, NY 12843 – (800) 328- 4283 or (888) 978- 4283.

B. Approved substitution – All other systems must be submitted to the design team in accordance with substitution requirements as set forth in the general provisions of the specification manual for approval prior to the bid date. Products submitted after the bid date will not be approved.

2.2 VEHICULAR SLIDE GATE OPERATOR TYM-SL-2000DC

A. The TYM-SL-2000DC slide gate operator comes equipped with a true integrated long term battery backup. It utilizes a Brushless DC motor and is equipped with a built in loop rack, slow start/stops algorithm, heavy duty frame, and emergency mechanical foot pedal release. The TYM-SL-2000DC offers up 80 cycles on a 1,000 # gate in the event of a power failure. In the event of a power failure it seamlessly switches from AC power to backup mode and runs off of its included (2 – 7Ah) batteries.

B. Specifications:

1. UL 325 and UL991 compliant.

2. The gate operator shall be rated to operate a gate weighing up to 2000 lbs.

3. Maximum gate opening length: 50 feet.

4. Gate Speed: 12 inches per second.

5. Motor: 1/2 HP – continuous duty cycle.

6. Power: 115/230 VAC Single Phase and 24 VDC solar panel.

7. Gear box ratio 20:1 with internal clutch.

8. Cover: Standard Plastic.

9. Dimensions: 12” wide x 17.5” long x 23.5” high.

10. Emergency Release: Mechanical foot pedal.

11. Integrated full time battery back up.

12. Battery: Two 7Ah batteries 12 VDC.

13. Solar Capabilities: 24 VDC solar panel input.

14. Supplied with #40 chain – Coated with “Armor Coat” corrosive resistant chain coating. Corrosive resistance exceeds nickel plating.

C. Access Control, Integration and Programming:

1. Entrapment Devices:

a. Photoelectric through beams / photo eyes shall be installed to span the clear opening and gate path at the tail section.

2. Control Devices:

a. Primary access to be through pedestal mounted pin-pad and card reader on the non-secure side of the gate. Gate is to open and remain open until close command is given via pin-pad or keypad.

b. Control devices shall be a combination of a pin pad and card reader.

c. Installer shall coordinate with Building Security Integration to ensure card reader for the buildings are same as card readers for the gate operation.

d. Gate Operator shall have intercom system to communicate with New Control Building in case the gate is closed.

3. Operator Programming

a. Gate Operator shall be programmed such that the gate shall open and remain open until a close command is given or operate on a normal cycle where the gate open and closes after a vehicle passes.

D. Factory Inspection and Testing:

1. Manufacturer shall test each operator at factory to assure smooth, quiet operation.

2. Manufacturer shall test all control inputs to ensure proper function.

2.3 CANTILEVER SLIDE GATE

A. Gate Width:

1. Heavy Duty Gate may be used for clear opening up to 30’ wide.

B. Heavy Duty Gate Frame:

1. The gate frame shall be fabricated from 6063-T6 aluminum alloy extrusions. The top member shall be a 3” x 5” (76mm x 127mm) aluminum structural channel/tube extrusion weighing not less than 3.0 lb/lf (4.4kg/m). To maintain structural integrity this frame member shall be “keyed” to interlock with the “keyed” track member. If fabricated as a single horizontal piece, the bottom member shall be a 2” x 5” (51mm x 127mm) aluminum structural tube weighing not less than 2.0 lb/lf (2.9kg/m). If fabricated in two horizontal pieces, the bottom member shall be a 5” (127mm) aluminum structural channel weighing not less than 2.6 lb/lf (3.8kg/m). When the gate frame is manufactured in two horizontal pieces or sections, they shall be spliced in the field (the gate frame shall be fabricated in one or multiple sections depending on size requirements or project constraints).

2. Vertical Members:

a. The vertical members at the ends of the gate frame shall be “P” shaped in cross section with a nominal base dimension of no less than 2” x 2” (51mm x 51mm) and weighing not less than 1.6 lb/lf (2.3kg/m). Major 2” x 2” (51mm x 51mm) vertical members weighing not less than 1.1 lb/lf shall separate each bay and shall be spaced at less than gate height intervals.

b. Intermediate 1” by 2” (25mm x 51mm) vertical members weighing not less than .82 lb/lf shall alternate between 2” x 2” major members.

C. Gate Track:

1. The gate frame shall have a separate semi-enclosed “keyed” track, extruding from 6005A-T61 or 6105-T5 aluminum alloy, weighing not less than 2.9 lb/lf (4.2kg/m). The track member is to be located on only one side of the top primary. Welds to be placed alternatively along the top and side of the track at 9” (229mm) centers with welds being a minimum of 2” (51mm).

D. All welds on the gate frame shall conform to Welding Procedure Specification and Procedure Qualification Record to insure conformance to the AWS D1.2 Structural Welding Code. All individual welders shall be certified to AWS D1.2 welding code. See 1.2 D.

E. Gate Mounting:

1. The gate frame is to be supported from the track by two (2) swivel type, self-aligning, 4-wheeled, sealed lubricant, ball-bearing truck assemblies.

2. The bottom of each support post shall have a bracket equipped with a pair of 3” (76mm) UHMW guide wheels. Wheel cover protectors shall be included with bottom guides to comply with UL325.

3. Gap protectors shall be provided and installed, compliant with ASTM F-2200-05.

F. Diagonal Bracing:

1. Diagonal “X” bracing of 1/4” diameter stainless or galvanized steel cable shall be installed throughout the entire gate frame.

G. The gate shall be completed by installation or approved filler as specified.

1. Chain Link: 2” x 2” x 9 gauge aluminum steel chain link fabric shall extend the entire length of the gate (if operated gate, counterbalance must also have fabric to prevent reach through and comply with ASTM F2200, see 1.3 C.1) Fabric shall be attached at each end of the gate frame by standard fence industry tension bars and tied at each 2” x 2” (51mm x 51mm) vertical member with standard fence industry ties. ASTM F2200 requires attachment method that leaves no leading or bottom edge protrusions (cannot exceed 0.5 inch).

H. Posts:

1. A single set of support posts shall be minimum 4” O.D. (102mm) round SS40 or 4” x 4” x 3/16” wall square steel tubing, grade 500. Gate posts shall be galvanized or coated and supported in concrete footings as specified by the design team.

I. Finish:

1. Gate to be mill finish aluminum or color coated with polyester powder as specified. If powder coated, the gate (including track member) and all accessories shall be pretreated chemically by sand blasting or other acceptable method to ensure proper coating adherence.

2.4 WARRANTY

A. The cantilever slide gate and operator system shall be warranted by the manufacturer against manufacturing defects for a period of (3) three years from the date of sale. The truck assembly shall be warranted against manufacturing defects by the manufacturer for a period of (5) five years from date of sale. Line post selection based on wind speed is described in CLFMI WLG 2445.

PART 3 - EXECUTION

3.1 SITE INSPECTION

A. Examine final grades and installation conditions.

B. Do not begin work until all unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. Install equipment of this section in strict accordance with the company's printed instructions unless otherwise shown on the contract drawings.

B. The gate and installation shall conform to ASTM F 1184 standards for aluminum cantilever slide gates, Type II, Class 2. See 1.2 C.

C. The gate system is to comply with ASTM F2200 and UL 325. See 1.2 B and 1.2 A.

D. Obstruction Sensing System:

1. The inherent motor current sensors are part of the gate operator system and may not be removed or bypassed.

2. The installing contractor shall be responsible to ensure that appropriate external secondary entrapment protective devices be installed for the specific site conditions to protect against all potential entrapment zones. Proper operation of these safety devices shall be verified and training as to the operation and maintenance of these devices for the users and owners shall be documented.

3.3 SYSTEM ACCEPTANCE AND VALIDATION

A. Acceptance Test:

1. Test each system function.

2. Supply all equipment necessary for system adjustment and testing.

B. Test and Explain Safety Features:

1. Each system feature and device is a separate component of the gate system.

2. Read and follow all instruction for each component.

3. Ensure that all instructions for mechanical components, safety devices and the gate operator are available for everyone who will be using the gate system.

4. The warning signs shipped with the gate operator must be installed in prominent position on both sides of the gate.

C. System Validation:

1. The complete system shall be adjusted to assure it is performing properly.

2. The system shall be operated for a sufficient period of time to determine that the system is in proper working order.

3. Ensure the owner is clear with regard to the safety points concerning the basic operational guidelines of the safety features of the gate operator system. These safety points are listed in the operator manual and must be read prior to system use.

4. Installer and customer shall complete Operated Gate System Installation Checklist (see operator manual).

END OF SECTION 323100

SECTION 323113 - CHAIN LINK FENCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Chain-link fences.
2. Privacy slats.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of fence and gate assembly.

1. Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each exposed product and for each color and texture specified.

D. Delegated-Design Submittal: For structural performance of chain-link fence frameworks, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Product test reports.

C. Sample warranty.

1.5 WARRANTY

A. Special Warranty: Installer agrees to repair or replace components of chain-link fences that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CHAIN-LINK FENCE FABRIC

A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist according to "CLFMI Product Manual" and requirements indicated below:

1. Fabric Height: 6’-0” As indicated on Drawings.
2. Steel Wire for Fabric: Wire diameter of 0.192 inch.

    a. Mesh Size: 2 inches.
    b. Polymer-Coated Fabric: ASTM F668, Class 1 over zinc-coated steel wire.

        1) Color: As selected by Engineer/Architect from manufacturer's full range, according to ASTM F934.

    c. Coat selvage ends of metallic-coated fabric before the weaving process with manufacturer's standard clear protective coating.

3. Selvage: Knuckled at both selvages.

2.2 FENCE FRAMEWORK

A. Posts and Rails: ASTM F1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F1043 or ASTM F1083 based on the following:

1. Fence Height: As indicated on Drawings 6’-0”.
2. Heavy-Industrial-Strength Material: Group IA, round steel pipe, Schedule 40.

    a. Line Post: 4.0 inches in diameter.
    b. End, Corner, and Pull Posts: 4.0 inches in diameter.

3. Horizontal Framework Members: Intermediate top and bottom rails according to ASTM F1043.
4. Brace Rails: ASTM F1043.
5. Metallic Coating for Steel Framework:

    a. Type A zinc coating.
    b. Type B zinc with organic overcoat.
    c. External, Type B zinc with organic overcoat and internal, Type D zinc-pigmented coating.
    d. Type C, Zn-5-Al-MM alloy coating.
    e. Coatings: Any coating above.

6. Polymer coating over metallic coating.

a. Color: As selected by Engineer/Architect from manufacturer's full range, according to ASTM F934.

2.3 TENSION WIRE

A. Metallic-Coated Steel Wire: 0.177-inch-diameter, marcelled tension wire according to ASTM A817 or ASTM A824, with the following metallic coating:

1. Type I: Aluminum coated (aluminized).
2. Type II: Zinc coated (galvanized) with minimum coating weight matching chain-link fabric coating weight.
3. Type III: Zn-5-Al-MM alloy with the following minimum coating weight matching chain-link fabric coating weight.

B. Polymer-Coated Steel Wire: 0.177-inch- diameter, tension wire according to ASTM F1664, Class 1 over zinc-coated steel wire.

1. Color: As selected by Engineer/Architect from manufacturer's full range, according to ASTM F934.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation before final grading is completed unless otherwise permitted by Engineer. Final grades and installation conditions shall be examined. Installation shall not begin until all unsatisfactory conditions are corrected.

3.2 CHAIN-LINK FENCE INSTALLATION

A. Install chain-link fencing according to ASTM F567 and more stringent requirements specified.

B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.

C. Post Setting: Set posts with mechanical anchors at indicated spacing into firm, undisturbed soil.

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.

D. Terminal Posts: Install terminal end, corner, and gate posts according to ASTM F567 and terminal pull posts at changes in horizontal or vertical alignment of 15 degrees or more. For runs exceeding 500 feet, space pull posts an equal distance between corner or end posts.

E. Line Posts: Space line posts uniformly at 96 inches o.c.

F. Tension Wire: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch-diameter

hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:

1. Extended along top and bottom of fence fabric.

G. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 2-inch bottom clearance between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

H. Privacy Slats: Install slats in direction indicated, securely locked in place.

1. Diagonally for privacy factor of 80 to 85.

I. Barbed Wire: Install barbed wire uniformly spaced, angled toward security side of fence. Pull wire taut, install securely to extension arms, and secure to end post or terminal arms.

END OF SECTION 323113

323216 - PRE-CAST MODULAR BLOCK RETAINING WALL SYSTEM

PART 1- GENERAL

1.1 SUMMARY

A. Section Includes:

1. Work includes furnishing and installing precast modular blocks (PMB) to the lines and grades shown on the plans and as specified herein. Also included is furnishing and installing appurtenant materials required for construction of the complete system.

2. The contractor is solely responsible for safety. The Engineer and Owner shall not be responsible for means or methods of construction for safety of workers or the public.

1.2 REFERENCES

A. ASTM - American Society for Testing and Materials (AASHTO - American Association of State and Highway Transportation Officials)

B. ASTM C33 - Standard Specification for Concrete Aggregates (AASHTO M43)

C. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens (AASHTO T22)

D. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregate (AASHTO T27)

E. ASTM C1776 - Standard Specification for Wet-Cast Precast Modular Retaining Wall Units

F. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils (AASHTO T89 & T90)

G. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (AASHTO T99)

H. ASTM D4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles

I. ASTM D4595 - Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method

J. ASTM D5262 - Standard Test Method for Evaluating the Unconfined Creep Behavior of Geosynthetics

K. ASTM D6638 - Standard Test Method for Determining Connection Strength Between Geosynthetic Reinforcement and Segmental Concrete Units (Modular Concrete Blocks)

L. ASTM D6916 - Standard Test Method for Determining the Shear Strength Between Segmental Concrete Units

1.3 SUBMITTALS

A. If a complete design is not depicted in the plans, submit for review shop drawings for the retaining wall system prepared by a Professional Engineer registered in the state of New York. The shop drawings shall indicate the layout, height, and construction details of the retaining wall system. Upon request, design calculations shall also be submitted. Minimum safety factors for design shall be as follows:

	Gravity Wall
Sliding	1.5
Overturning	1.5
Bearing	2.0

B. If stain will be applied to the wall system, a sample shall be stained on site for review and approval by the Owner/Engineer. The color sample may be part of the completed wall, but shall be located in an inconspicuous area.

C. Submit grain size test results for aggregates to be used for the wall base and for unit fill.

D. Submit test results on borrow material to be used for common backfill and for select backfill (if used) including Proctor and grain size or Atterberg limits results.

1.4 DELIVERY, STORAGE AND HANDLING

A. Contractor shall check the materials upon delivery to assure that proper materials have been received.

B. Contractor shall protect the materials from damage. Damaged material shall not be incorporated into the wall or the reinforced soil embankments.

C. Contractor shall prevent excessive mud, concrete, adhesives and other substances that may adhere from coming in contact with the materials.

D. Exposed faces of precast modular block units shall be reasonably free of chips, cracks, or stains when viewed from a distance of 10 feet (3 m).

PART 2: MATERIALS

2.1 WALL UNITS

A. Precast modular blocks shall be Stone Strong units manufactured under license from Stone Strong LLC or an approved equal.

B. Wall units shall conform to ASTM C1776.

C. Dimension tolerances for precast modular blocks shall be +/- 1/8 inch (+/-3 mm) for height, +/- 1/8 inch (+/-3 mm) for length (along face), and +1/2 to -1/4 inch (+13 mm to -6 mm) for width (face to tail).

D. Concrete for precast modular blocks shall have a minimum 28-day compressive strength of 4,000 psi (28 MPa). Entrained air content shall be between 5 and 7%.

E. Internal unit reinforcement or unreinforced units shall be provided according to published Stone Strong engineering guidance. Reinforced units shall be marked with the type of reinforcement.

F. The face pattern shall be selected from the manufacturer's standard molds. The color of the units shall be natural gray. A concrete stain may be field applied to color the units if specified by the Engineer or Owner.

2.2 WALL BASE

A. The wall base shall consist of dense graded crushed aggregate. A minimum of 75% of coarse material shall have 2 or more fractured faces. Wall base material shall meet the following gradation:

US Standard Sieve Size	Metric Standard Sieve Size	Percent Passing
1-1/2"	37.5 mm	80-100
3/4"	19.0 mm	50-90
#4	4.75 mm	0-40
#200	75 μm	0-10

B. The contractor may substitute concrete with a minimum 28-day compressive strength of 3,000 psi (21 Mpa) for the granular base material. Concrete may be placed full thickness or as a topping over a compacted granular the base. If used as a topping, the concrete shall have a minimum thickness of 3 inches (75 mm).

2.3 UNIT FILL

A. Unit fill shall consist of a screened crushed aggregate. A minimum of 75% of coarse material shall have 2 or more fractured faces. Unit fill material shall meet the following gradation:

US Standard Sieve Size	Metric Standard Sieve Size	Percent Passing
1-1/2"	37.5 mm	100
3/4"	19.0 mm	50-90
#4	4.75 mm	0-10
#8	2.36 mm	0-5

2.4 BACKFILL

A. If a select granular reinforced zone is indicated, it shall consist of fill sand or other clean aggregate meeting the following gradation:

US Standard Sieve Size	Metric Standard Sieve Size	Percent Passing
3/4"	19.0 mm	100
#200	75 μm	0-5

C. All other backfill behind and in front of the wall shall consist of suitable on-site soil or imported borrow and shall be approved by the Geotechnical Engineer. Backfill shall generally consist of sands, silts, or lean clays with a liquid limit less than 45 and a plasticity index less than 20. Fat clay soils, cobbles, and large rock should generally be avoided unless approved by the Geotechnical Engineer based on local practices. Frozen soils, excessively wet or dry soils, debris, and deleterious materials should not be used.

2.5 DRAIN TILE

A. Drain tile shall be a perforated or slotted PVC or corrugated HDPE pipe. The drain tile should be connected to storm drains or daylighted at low points and/or periodically along the wall alignment as shown on the plans.

2.6 GEOTEXTILE FABRIC

A. Provide a geotextile filter for separation from backfill at the tails of the blocks. The geotextile shall be a needle punched non-woven fabric with a minimum grab tensile strength of 120 pounds (534 N). The geotextile may cover the entire back face of the blocks or may be cut in strips to cover the gaps between tail units with a minimum of 6 inches (150 mm) of overlap over the concrete tail on both sides.

PART 3: EXECUTION

3.1 EXCAVATION

A. Excavate as required for installation of the retaining wall system. Excavate to the base level for a sufficient distance behind the face to permit installation of the base.

B. Slope or shore excavation as necessary for safety and for conformance with applicable OSHA requirements.

3.2 WALL BASE

A. Foundation soils shall be excavated to the dimensions shown on the plans. Foundation soil shall be observed by the Geotechnical Engineer to confirm that the bearing soils are similar to the design conditions or assumptions.

B. Construct the wall base to the lines and grades shown on the plans. Place and consolidate concrete, strike, and finish plane and level. Overexcavated areas shall be filled with additional concrete or granular base material. Compact granular base material to provide a hard and level surface to support the wall units. Base material shall be compacted to a minimum of 95 percent of the maximum dry density (ASTM D698, Standard Proctor). Final base elevation shall be within 0.1 feet (30 mm) of plan elevation.

C. Prepare and smooth the granular material to ensure complete contact of the first course with the base. The base may be dressed with fine aggregate to aid leveling.

3.3 UNIT INSTALLATION

A. Place the first course of units directly on the wall base. Check units for level and alignment. Units shall be within 1/8 inch (3 mm) of level from end to end and from front to back. Adjacent units should be in contact. If possible, begin placing units at the lowest section of the wall.

B. Fill all voids between and within the blocks with granular unit fill. Additional unit fill is not required behind the units, but may be placed for the convenience of the contractor.

C. Place backfill behind the units in maximum loose lifts of 8 inches (200 mm) and compact. Compact all backfill to a minimum of 95 percent of the maximum dry density (ASTM D698, Standard Proctor). For cohesive soils, the moisture content at the time of compaction should

be adjusted to within -2 and +3 percent of optimum. Place backfill in successive lifts until level with the top of the facing unit.

D. Remove all excess aggregate and other materials from the top of the units before laying up the next course.

E. Place the next course of precast modular block units in running bond with the previous course. Place the web recess over the alignment hoop protruding from the unit below, and pull the unit forward to contact the hoop. Batter should be within ¼ inch (6 mm) tolerance (4 inches/102 mm from 24 SF unit below, 2 inches/51 mm from 6 SF unit below).

F. Continue placing successive courses to the elevations shown on the plans. Construct wall in level stages, placing the units at each course for the entire length of the wall, if possible. Unit fill and backfill should be placed to the level of the top of the facing unit before placing the next course.

G. Provide temporary swales to divert runoff away from wall excavation and away from face.

H. Final grade above and below the retaining wall shall provide for positive drainage and prevent ponding. Protect completed wall from other construction. Do not operate large equipment or store materials above the wall that exceed the design surcharge loads.

PART 4: CONSTRUCTION QUALITY CONTROL AND ASSURANCE

4.1 CONSTRUCTION QUALITY CONTROL

A. The contractor is responsible to ensure that all installation and materials meet the quality specified in the construction drawings.

B. The contractor shall verify that installation is in accordance with the specifications and construction drawings.

4.2 QUALITY ASSURANCE

A. The owner is responsible to engage testing and inspection services to provide independent quality construction assurance.

B. Compaction testing shall be done a minimum of every 1 foot (300 mm) of vertical fill and every 100 lineal feet (30 m) along the wall.

C. Testing shall be done at a variety of locations to cover the entire backfill zone.

D. The independent inspection professional should perform sufficient testing and observation to verify that wall installation substantially conforms to the design drawings and specifications.

END OF SECTION 323216

SECTION 329119.13 - TOPSOIL PLACEMENT AND GRADING (TOPSOIL)

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Furnishing and placing topsoil in conformance with the lines, grades and thicknesses shown on the plans or as required for acceptance by the Engineer.

B. Furnishing and placing topsoil in conformance with the minimum requirements as noted under other Contract Work Items (i.e. Seeding, Topsoil and Sodding, etc.).

1.2 RELATED WORK:

A. Trenching, Backfilling and Compaction – Section 312333

B. Seeding - Section 329219

C. Finish Grading – Section 312219

D. Erosion and Sediment Control – Section 312500

1.3 EXISTING CONDITIONS:

A. It shall be the Contractor's responsibility to investigate all site conditions that may affect his work.

PART 2 - MATERIALS

2.1 GENERAL:

A. Ordinary topsoil shall be the surface layer of soil and sod, suitable for use in seeding and planting.

B. Ordinary topsoil or Topsoil from Borrow shall be friable, loamy and contain no mixture of refuse or any substance toxic to plant growth, and shall be free from sub-soil, debris, stumps, brush, roots, clay lumps, stones, or similar objects larger than 3/8 inches (0.375") in greatest dimension.

C. The topsoil or soil mixture, unless otherwise specified, shall have an acidity range of approximately 6.0 pH to 7.6 pH, when tested according to the methods of A.O.A.C., in effect on the date of the invitation to bids.

D. The organic content shall be not less than 6% nor more than 12% as determined by the wet combustion method (chromic acid reduction).

E. There shall be not less than 10% nor more than 30% passing the 200-mesh sieve as determined by the

wash test made in accordance with the standard test ASTM Designation D1140.

F. Natural topsoil may be amended by the Contractor with acceptable materials and methods, to meet the above specifications.

2.2 QUALITY ASSURANCE:

A. Samples of the topsoil or soil mixture will be taken by the Owner or his designated representative.

B. All topsoil from borrow will be tested unless otherwise accepted.

C. Testing may be done by the U.S. Department of Agriculture, Soil Conservation Service, the New York State Department of Transportation, Bureau of Soil Mechanics, or any independent testing laboratory acceptable to the Owner and Engineer.

D. The Contractor shall notify the Engineer of the intended source of material at least three (3) weeks in advance of the scheduled use of the material, to allow time for sampling, shipping of the sample and testing.

E. If at any time the quality of the topsoil being utilized becomes questionable, the Contractor shall perform such additional testing as necessary to demonstrate the acceptability of the material being used.

F. The Contractor shall furnish, at his own expense, suitable excavating equipment as required for taking of samples by the Owner or his representative.

G. All costs for sampling and testing shall be borne by the Contractor and shall be deemed included in the unit price bid for topsoil or the associated Items.

PART 3 - CONSTRUCTION DETAILS

3.1 GENERAL:

A. Placement of topsoil shall be in strict accordance with the details shown and the specific requirement of the related specifications.

B. No material shall be utilized unless it meets all the "Material" and test requirements.

3.2 SUB-SOIL PREPARATION:

A. The sub-soil within the areas to be covered by topsoil shall be graded so that the completed work shall conform to the specified lines and grades.

B. Unless otherwise noted or accepted, the Contractor shall scarify or till the surface of the sub-soil before the topsoil is placed to permit bonding of the topsoil with the sub-soil.

C. Tillage by disking, harrowing, raking, or by other methods acceptable to the Engineer shall be

accomplished in such a manner that depressions and ridges formed by the tillage shall be parallel to the contours.

D. Brush and vegetation which will not be incorporated with the soil during handling operations shall be cut and removed prior to stripping.

3.3 TOPSOIL PLACEMENT:

A. Topsoil in an unworkable condition due to excessive moisture shall not be placed until it is suitable for spreading.

B. Topsoil shall be placed on the designated areas and spread to the specified thickness.

C. After the topsoil is spread, all large soil clogs, rocks, roots and other foreign material shall be cleared and disposed of by the Contractor so that the finished surface will be acceptable for subsequent work, such as seeding, sodding, mulching or planting.

D. Ordinary sods and herbaceous growth, such as grass and weeds, are not to be removed but shall be thoroughly broken up and intermixed with the soil during handling operations.

3.4 EROSION CONTROL:

A. It is the responsibility of the contractor to ensure that the soil of the topsoil preparation area is not blown or washed from the site and that nearby areas are protected from soil, fertilizer, compost, etc.

B. In the event of heavy rain or wind that cause damage to the site, then the contractor will repair the damaged areas so they are restored to a condition acceptable under the specifications.

C. Watering of seeded areas will be done with equipment necessary to prevent seed from being displaced from its original location.

3.5 ACCEPTANCE OF WORK:

A. A uniform grade will be established so that no depressions or elevations are present, and so that the safe and effective operation of mowing equipment will not be hindered after the turf grass is established.

B. The topsoil will not be loose whereby footprints greater than 0.5 inch are observed, nor will it be too dense whereby only footprints less than one-quarter of an inch are observed.

3.6 ACCEPTANCE OF WORK:

A. Prior to final completion, the Engineer will make the final inspection and consideration acceptance of the seeding.

B. No relief will be granted to the Contractor for the failure of turf to establish for any reason.

C. Satisfactory seeded turf will be healthy in color, uniform, free of weeds and surface irregularities, with coverage exceeding 95% and bare spots not exceeding 4 inches x 4 inches. No erosion washes, clumps or deformation of the turf area caused by mowing or other Contractor equipment will be allowed.

PART 4 - MEASUREMENT AND PAYMENT

4.1 PAYMENT:

A. Where topsoil work is called for as part of individual Contract Items, the cost for all work related to the topsoiling, as required by this specification, shall be included in the individual prices bid for the respective Contract Item.

B. If the Contract Proposal includes a separate "Topsoiling" Item, the cost for all work related to all topsoiling, not included under any other items, shall be paid for under the price bid under the "Topsoiling" Item. If no such item for payment is provided within the Proposal, all topsoiling costs shall be deemed included in the other prices bid in the Proposal, and no separate payment for this work shall be made.

END OF SECTION 329119.13

SECTION 329219 - SEEDING

PART 1- GENERAL

1.1 WORK INCLUDED:

A. Preparing all ground surfaces as required.

B. Furnishing and sowing seed on areas shown on the plans, all other disturbed areas, and areas of restoration and caring for the work as specified.

C. Action and means as necessary for control of soil erosion and stability maintenance.

1.2 RELATED WORK:

A. Finish Grading - Section 312219

B. Topsoil Placement and Grading – Section 329119.13

C. Erosion and Sediment Control – Section 312500

1.3 EXISTING CONDITIONS:

A. It shall be the Contractor's responsibility to investigate all site conditions that may affect his work.

PART 2 - MATERIALS

2.1 GENERAL:

A. Each of the species, variety and strain of grasses, legumes and cereals shall be as specified, unless otherwise acceptable to the Engineer.

B. All seed and seed labels shall be in accordance with State and Federal Laws, Rules and Regulations as each is in effect on the date of Invitation for Bids.

2.2 SEED LOT CONTENT:

A. The weight of pure live seed in each lot of seed is computed by the labeled purity percent, times the labeled germination percent, times the weight. (Example: 34 pounds of pure live seed of a particular grass is required. Stock available has 85% purity and 80% germination which meets the minimum requirements in this example and equals 68% pure live seed; 34 divided by 68%

equals 50 pounds gross as being required to furnish the 34 pounds of pure live seed.) Other material shall comprise the remaining 32% between 68% of pure live seed and 100% in the example.

B. The Contractor shall furnish the vendor with the specifications for the material. Seed mixes shall be as follows:

NAME	VARIETY	WT. OF PURE LIVE SEED
Red Fescue (Festuca rubra)	Commercial	40
Kentucky Bluegrass (Poa Pratensis)	Commercial	10
Perennial Ryegrass (Lolium perenne)	Commercial	15
White Clover (Trifolium repens)	Commercial max.25% hard seed	5
TOTAL		70 lbs.

C. Material other than the pure live seed shall comprise only non-viable seed, chaff hulls, live seed of crop plants other than those specified, harmless inert matter and weed seeds, except that weed seeds, other than seeds of noxious weeds will be permitted up to 1% of the gross weight of each kind of seed. Legume seeds shall be accompanied by adequate amounts of their proper inoculants unless accompanied by certification of pre-inoculation.

2.3 INOCULATION:

A. All the seed of leguminous plants shall be inoculated prior to mixing or sowing unless otherwise specified or approved or unless accompanied by a certificate of pre-inoculation. It is very important to use crownwatch inoculant at double the usual rate; follow carefully the instructions on the inoculant bag. When seed is to be sown dry and is to be inoculated, the culture shall be applied as directed by the manufacturer and seed allowed to dry sufficiently to be in the proper condition for mixing or sowing. Seed must be sown within thirty (30) hours after this treatment. When seed is to be distributed by water pressure, proper proportion of inoculant may be added to water and seed mixture, together with any limestone or fertilizer specified, providing the alkalinity of the solution does not exceed a pH of 8.

B. The inoculants for treating seeds of legumes shall be standard culture of nitrogen fixing bacteria not more than one (1) year old. Each inoculant shall be the specific culture required by each legume. It shall be supplied only from the manufacturers licensed to sell legume inoculants in New York State.

PART 3 - CONSTRUCTION DETAILS

3.1 GENERAL:

A. Each kind of seed shall be furnished and delivered, unless otherwise approved, in separate, sealed containers, or bags acceptably sewn tight or sealed.

B. The percentage of purity as shown on the label will be acceptable if in conformance with these specifications. Percentage of germination as shown on the label shall not be less than the minimum percentage specified. The common and scientific names of the grasses, legumes and cereals under this contract are in conformity with the Standardized Plant Names adopted by the American Joint Committee on Horticulture Nomenclature and in effect on the date of the Invitation for Bids.

C. The seeds shall meet the minimum specified requirements regardless of the guarantee of the qualities or dates of testing.

3.2 TIME FOR WORK:

A. This work may be performed at any season of the year when a mulch is used unless otherwise specified.

B. When conditions of high winds, excessive moisture, or ice are such, that satisfactory results are not likely to be obtained, the work shall be stopped, and will be resumed only when the desired results are likely to be obtained or when acceptable corrective measures and procedures are adopted.

C. The Contractor shall notify the Engineer at least forty-eight (48) hours in advance of the time he intends to begin sowing seed and shall not proceed with such work until permission to do so has been obtained.

3.3 ACCEPTANCE:

A. Provisional acceptance of the seeds must be obtained before the seeds are mixed. Each lot of seed shall be subject to sampling and testing before mixing. Sowing seed shall not be delayed pending reports of these tests. Sampling shall be accomplished by the Owner's Representative. Seeds of the kind specified shall be mixed on the job in the formula specified unless otherwise accepted. Seed mixed prior to delivery may be accepted on the basis of certification by the vendor stating the minimum percentage of germination and purity of each kind of seed and the quantity of each kind of seed in the mixture.

B. The provisional acceptance of seeds must be obtained before the seed is sown. Final acceptance may be subject to the results of official sampling and testing.

3.4 STORAGE:

A. Seed after delivery to the Contractor shall be stored in such a manner as to protect it from damage or deterioration from any source.

B. Seed, which has become wet, moldy, or otherwise damaged in transit or storage will not be acceptable and shall be removed from the site immediately upon such damage being discovered.

3.5 MAINTENANCE:

A. Areas to be seeded shall be maintained at acceptable grades. Irregularities, which will form low places and hold water shall be eliminated. Limestone, fertilizers, and seeds in amounts specified shall be evenly distributed on the surfaces to be seeded. Rates, unless otherwise specified, are as follows:

1. Fertilizer - 800 pounds/acre (20 pounds/1,000 sq. ft.)
2. Seed - 150 pounds of pure live seed/acre

B. Agriculture limestone, fertilizer and seed may be mixed together immediately before placing. Any method of distribution, such as by air or water pressure, will be acceptable except that the seed shall not be injured in the process of spreading.

C. The Contractor shall care for the seeded and mulched areas until final acceptance of the project. Such care shall consist of repairing any areas damaged following the seeding or mulching operations due to wind, water, fire or other causes. Such damaged areas shall be repaired to re-establish the condition and grade of the area prior to seeding, and shall then be refertilized, re-seeded and re-mulched as specified herein.

END OF SECTION – 329219

330110.13 - PRESSURE AND LEAKAGE TESTING OF PIPELINES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY:

A. The Contractor shall pressure test all potable water pressure and sewer forcemain pipelines shown on the contract drawings. All piping and equipment shall be tested in the field in the presence of the Engineer.

B. Prior to testing, all mains shall be flushed and pigged to remove all sand and other foreign matter. Flushing shall be terminated at the direction of the Engineer. The Contractor shall dispose of the flushing water without causing a nuisance or property damage.

C. No testing shall be done until all joints are restrained. Temporary thrust blocks or reverse deadmen may be used with the Engineer's prior approval.

1.3 RELATED SECTIONS:

A. Related Sections include the following:

1. Division 33 Sections for buried pipe installation requirements.
2. Division 33 Section "Disinfection of Pipelines" for disinfection testing requirements of pipelines.

1.4 SUBMITTALS:

A. For closeout: Pressure Test Reports performed as well as any laboratory results received as part of this work. Specifically:
1. Pressure Report:
2. Hydrostatic Test Pressure.
3. Dates and time for start and completion of pressure testing.
4. Pressure results at start and finish of each section tested.
5. Amount of Water Used during testing.
6. Signature of person performing tests and signature of witness.

B. Certificate: Certify that pressure testing of water distribution system meets or exceeds requirements of the AWWA.

PART 2 – PRODUCTS

PART 3 - EXECUTION

3.1 GENERAL:

A. All hydrant control valves must be open while pressure testing.

B. All blow-off standpipes and injection points shall be removed upon satisfactory completion of sampling and testing. Corporation stops shall remain in line.

C. Teflon tape shall be used on all threaded joints to avoid contamination (No pipe dope allowed).

D. It is the Contractor's sole responsibility to place sample points where designated by the Design Engineer.

E. The Contractor shall backfill all pipe and thrust blocking before pressure testing unless the Engineer directs certain joints or connections left uncovered. Where thrust blocking is provided the pressure test shall not be made until at least five days after the thrust blocking has been installed. A high early strength concrete may be used to reduce this time.

F. Each valved section of pipe shall be slowly filled with water and a pump shall be hooked to the pipe in a manner satisfactory to the Engineer to supply the test pressure. The pump, pipe connection and all necessary apparatus shall be furnished by the Contractor.

G. While the system is being filled with water, air shall be carefully and completely exhausted. If permanent air vents are not located at all high points, the Contractor shall install corporation stops or fittings and valves at such points so the air can be expelled as the pipe system is slowly filled with water. Service shall be tested as part of the main pipeline.

H. Source water that is from a public water supply shall use backflow protection. A double check valve assembly or better device approved by the New York State Department of Health is acceptable.

3.2 PRESSURE TEST FOR DUCTILE IRON AND PVC PIPING

A. All newly laid pipe, including fitting and valves shall be pressure tested by the Contractor, in accordance with the latest editions of AWWA C600 and C605, to verify the integrity of the pipeline.

B. Test pressures and durations shall be as follows:

	Pressure (psi)	Duration (hrs)
Sewage force main	150	2
Reclaimed water mains	150	2
Potable water mains	150	2
Fire mains	200	2

*Water mains should be tested at 1.5 times the working pressure.

C. A leakage test shall be conducted in the presence of the Engineer and, after the pressure test has been satisfactorily completed. The Contractor shall, as before, furnish all pumps, pipe, connections and other items required to satisfactorily complete the leakage test. The leakage test shall have a duration of two hours at the pressure specified for the pressure test. No pipe installation will be accepted if the leakage is greater than that determined by the formula for mechanical and push-on joints per hour:

$$L = \frac{SDP^{1/2}}{148{,}000}$$

L= Allowable leakage [gph]
S= Length of pipe tested [feet]
D= Nominal diameter of pipe [inches]
P= Average pressure during test [psig]

150 psi (per 1000ft.) at 2 hours
(Per AWWA C600& AWWA C605 Tables)

Line Size (in)	Allowable Leakage (gal)
2	0.34
4	0.66
6	1.0
8	1.32
10	1.66
12	2.0
16	2.64
18	2.98
20	3.32
24	3.98
30	4.96
36	5.96
42	6.96
48	7.94
54	8.94

D. The Engineer, or his duly authorized representative, shall witness these tests. The Contractor shall be responsible for finding and repairing leaks. No additional cost may be incurred by the Owner due to repairs because of failure of the test. The Engineer has the authority to determine the number of repairs that will be made within a given length of pipe and has the right to request the Contractor to remove and relay a section of pipe if such does not comply with the established leakage rates as calculated using the formula above.

E. For the duration of the test, the pressure in the main shall not be allowed to drop more than 5 psi below the test pressure per AWWA C600 & C605. Should the pressure drop 5 psi, makeup water shall be added to the line to restore the pressure to the test pressure. This makeup water shall be measured and shall be included in the total leakage measured. If loss is greater than 5 psi, the test fails.

3.3 PRESSURE TESTING OF HDPE PIPELINES:

A. Filled pipelines shall be allowed to thermally stabilize such that the temperature of the water and the pipe are equal. At temperatures above one hundred (100) degrees F, the Engineer shall be consulted regarding the need to reduce the test pressure.

B. The piping shall be tested between valved sections to a maximum length of five thousand (5,000) feet.

C. For any test pressure from 1.0 to 1.5 times the system design pressure, the total test time including initial pressurization, initial expansion, and time at test pressure, shall not exceed eight hours. If the pressure test is not completed due to leakage, equipment failure or other reason, the test section shall be depressurized, and allowed to "relax" for at least eight hours before bringing the test section up to test pressure again.

D. The test procedure consists of initial expansion, and the test phase:
   1. During the initial expansion phase, the test section is pressurized to 10 psi above the test pressure (see Table A for Expansion Pressure), and sufficient make-up water is added each hour for three hours to return to the expansion phase pressure.
   2. After the initial expansion phase, about four hours after pressurization, the test phase begins.

   3. During the test phase, the pipe is stabilized at the test pressure (see Table A). The pressure shall remain steady within five percent of this target value for two hours. If the pressure drop is greater than 5% or if the pressure falls below 95% of the test pressure (see Table A), leakage or insufficient expansion is indicated, and the test shall be repeated after the pipe is allowed to "relax" as indicated above. Make-up water is not allowed during the test phase.

TABLE A

Pipe Class (SDR)	Expansion Pressure (psi)	Test Pressure (psi)	5% Reduction Pressure (psi)
17	150	140	133
13.5	170	160	152
11	170	160	152
9	210	200	190

3.4 REPAIR

A. The Contractor shall repair all leaks in the piping at no cost to the Owner.

PART 4 - MEASUREMENT AND PAYMENT:

4.1 MEASUREMENT:

A. Measurement shall be made on the basis of lineal foot of pipe of the type and size(s) properly placed, as measured by the Engineer. Measurements shall be made horizontally along the axis of the pipe and shall include all fittings and/or accessories not specifically included for measurement and payment under other items in the Proposal.

4.2 PAYMENT:

A. Payment will be made at the unit price bid under the appropriate item(s) of the Proposal.

END OF SECTION 330110.13

SECTION 330505.41 - LOW PRESSURE AIR TEST - SANITARY SEWER LINES

PART 1 – GENERAL

1.1 WORK INCLUDED:

A. This item shall govern for furnishing all labor, materials, tools and equipment and for performing low pressure air testing on completed sanitary sewer lines.

1.2 RELATED SECTIONS:

A. Trenching and Backfilling and Compaction Work – Section 312333

1.3 SUBMITTALS:

A. Conform to the requirements of Section 013300– Submittal Procedures

PART 2 – PRODUCTS

2.1 EQUIPMENT:

A. The equipment used shall meet the following requirements:

1. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe being tested.
2. Pneumatic plugs shall resist the internal test pressures without requiring external bracing or blocking.
3. One of the pneumatic plugs shall have an inlet tap or other provision for connecting air supply to introduce low pressure air into the line for testing.
4. All air used shall pass through a single control panel.
5. Air supply system shall have the necessary valves and gauges to control the rate at which air enters the test section and for reading test results.
6. Pressure gauges shall have minimum gradations of 0.1 psi and an accuracy of plus or minus 0.04 psi.

PART 3 – EXECUTION

3.1 GENERAL:

A. After the gravity sanitary sewer line has been laid and backfilled, but prior to replacement of pavement, the sanitary sewer line shall be subjected to a low pressure air test. Test shall be performed using equipment denoted herein and according to the outlined procedures.

B. The contractor shall take such precautions as required to prevent damage to the lines and appurtenances being tested. Damage resulting from any testing shall be repaired at the Contractor's expense. All testing shall be completed in the presence of the Engineer.

3.2 PRETESTING PROCEDURES:

A. In an area where groundwater is known to exist, prior to conducting any tests, the Contractor shall provide for determining groundwater level by installing groundwater gauges in the manholes.

B. Gauges shall consist of a minimum 1/2 inch diameter pipe, capped and inserted horizontally in the manhole wall as near as possible to the top of the sewer, sealed so as to be watertight. Immediately prior to the performance of the test, groundwater back pressure shall be determined by removing pipe cap, blowing air through the pipe into the ground to clean the pipe. Clear plastic tube shall be held vertically and measurement of height (in feet) of water over invert of pipe to be taken after water has stopped rising.

C. Height shall be divided by 2.3 feet to establish pounds (psi) of back pressure to be added to all readings. Upon satisfactory completion of the air test, remove the groundwater gauge from the wall of manhole and neatly and permanently close opening with a non-shrinking, noncorrosive grout. Prior to testing flush and clean sewer lines of any debris, also, plug all pipe outlets to resist test pressure.

3.3 TESTING PROCEDURES:

A. The testing procedure shall be as follows:

1. Seal-test all pneumatic plugs before using in the test installation. Lay one length of pipe on the ground and seal at both ends with the pneumatic plug. Introduce air into the pneumatic plug to 24 psig. Sealed pipe to be pressurized to 5 psig. Plugs shall hold against this pressure without external bracing.
2. Contractor shall carefully observe safety precautions during air testing; no one shall be allowed in the manholes during testing.
3. Place pneumatic plugs in the line at each manhole and inflate to 25 psig. Introduce low pressure air into sealed line until internal air pressure reaches a pressure of 4 psig plus the average groundwater back pressure. Allow two minutes for the internal air pressure to stabilize.
4. When the internal air pressure has stabilized and is at or above test pressure (3.5 psig minimum, plus groundwater back pressure), commence the test. Disconnect air hose from the control panel to the air supply. Record the pressure drop for the test period.
5. If the pressure drops more than 1.0 psig during the test period, line is presumed to have failed. Test may be discontinued, when the prescribed test time has been reached.
6. The time required for the pressure to decrease from 3.5 psig to 2.5 psig (greater than the average groundwater back to pressure over the pipe) to be not less than the time shown for the diameter given in Table No. 1. Times shown are based on loss of air not to exceed 0.003 cubic feet per minute per square foot of internal pipe surface tested at an average pressure of 3.0 psi greater than the groundwater back pressure.

Table No. 1
Allowable Time Table

Pipe Size(inches)	Min. Time Sec.
6	2 50
8	3 56
10	4 43
12	5 40
15	7 5
18	8 30

Pipe Size (inches)	Min. Time Sec.
21	9 55
24	11 20
27	12 45
30	14 10
36	17 0
42	19 50

7. Sanitary sewers failing to meet the requirements of the low pressure air test shall be tested again after the Contractor has located and remedied defects causing this failure. No sanitary sewer shall be accepted until the requirements of the test procedure are satisfied.

PART 4 - MEASUREMENT AND PAYMENT:

4.1 PAYMENT:

A. No separate payment for work performed under this item. Include the cost in the contract unit price bid for the item of which this work is a component.

END OF SECTION 330505.41

SECTION 330531.11 - POLYVINYL CHLORIDE (PVC) PIPE FOR NON-PRESSURE SEWER SERVICE

PART 1 – GENERAL

1.1 WORK INCLUDED:

A. This specification section includes all materials, equipment, labor, and incidentals required for the supply and installation of polyvinyl chloride (PVC) pipe and fittings, 4-inch diameter to 60-in diameter for use in storm sewer, sanitary sewer, or other non-pressure sewer applications.

1.2 RELATED SECTIONS:

A. Low Pressure Air Testing – Section 330505.41

B. Tracer Wire: Section 330598

C. Trenching, Backfilling and Compaction – Section 312333

1.3 REFERENCES:

A. The Contractor and/or Pipe Manufacturer shall follow the standards listed below, except as otherwise specified herein. The latest revision or edition in effect at the time of bid opening shall be utilized.

1. American Society for Testing and Materials (ASTM)
    a. D1784 – Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
    b. D2321 – Practice for Underground Installation of Thermoplastic Pipe for Sewer and Other Gravity-Flow Applications
    c. D3034 – Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
    d. D3212 – Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
    e. F477 – Elastomeric Seals (Gaskets) for Joining Plastic Pipe
    f. F679 – Polyvinyl Chloride (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
    g. F1417 – Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air
2. American Water Works Association (AWWA)
    a. M23 – PVC Pipe – Design and Installation
3. Uni-Bell PVC Pipe Association
    a. UNI-B-6 – Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe
    b. UNI-PUB-6 – Installation Guide for PVC Solid-Wall Sewer Pipe (4 - 48 in.)
    c. UNI-TR-3 – Maintenance of PVC Sewer Pipe
    d. Handbook of PVC Pipe Design and Construction

1.4 QUALIFICATIONS:

A. The Pipe Manufacturer shall be a member of the Uni-Bell PVC Pipe Association.

B. The pipe and fittings shall be designed, manufactured, and installed in accordance with industry standards and shall comply with the specification requirements herein.

1.5 SUBMITTALS:

A. Conform to the requirements of Section 013300– Submittal Procedures.

B. Submit product data on pipe, fittings, gaskets and appurtenances as required to ensure products meet the requirements of this specification.

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Pipe shall be shipped so as to not bend, dent, or otherwise damage the pipe during transport.

B. Contractor shall take all necessary precautions to prevent damage to pipe and fittings during delivery and unloading.

C. Owner shall observe and inspect unloading of pipe to ensure proper unloading procedures are followed.

D. Under no circumstances will pipe be allowed to be rolled, pushed, or dropped off from any height for delivery, storage, or installation. Any pipe found to have been damaged due to improper handling procedures truck will be immediately marked for identification and removed from the jobsite at the Contractor's expense.

E. Stacking of pipe shall be performed in accordance with Pipe Manufacturer's recommendations.

F. Once pipe has been unloaded, it shall be stored as near to its point of installation as possible. Contractor shall limit moving or restacking of pipe prior to installation.

G. Where necessary, because of ground conditions, store pipe on wooden sleepers, spaced suitably and of such widths as not to allow deformation of pipe at point of contact with sleeper or between supports.

H. Pipe shall not be stored close to heat sources or hot objects such as heaters, boilers, steam lines, and engine exhaust.

I. If pipe is to be exposed to direct sunlight for extended periods (in excess of two years from the date of manufacture), then Contractor shall cover/shade pipe utilizing canvas or other opaque materials. Black plastic will not be acceptable as a shading material.

J. Gaskets shall be protected from exposure to excessive heat, prolonged direct sunlight, and oil and grease.

K. Material storage shall be performed in accordance with Pipe Manufacturer's recommendations.

PART 2 – PRODUCTS

2.1 PIPE:

A. Pipe shall be manufactured and supplied in accordance with ASTM D3034 (4-Inch to 15-Inch) or F679 (18-Inch to 60-Inch).
   1. Pipe should have a standard dimension ratio (SDR) of SDR 35.

B. Pipe shall have lay lengths between 14 and 22 feet unless otherwise specified by the Owner.

C. The pipe shall be made of PVC compound having a cell classification of 12454 or 12364 in accordance with ASTM D1784.

D. Pipe shall be homogenous throughout, free of voids, cracks, inclusions, and other defects.

E. Pipe shall have markings at intervals of 5ft or less including:
   1. Manufacturer's name or trademark and code
   2. Nominal pipe size
   3. PVC cell classification
   4. Legend (e.g. " SDR-41 PVC Sewer Pipe" or "PS 46 PVC Sewer Pipe")
   5. ASTM Designation
   6. Gasketed pipe shall be marked with an insertion depth mark on the spigot end.

F. Pipe for non-potable water and wastewater uses shall be green or white in color.

G. Pipe outside diameters shall be equal to those of cast iron unless otherwise specified by the Owner.

2.2 PIPE DESIGN:

A. Pipe shall be supplied to meet the external loading requirements of the project as follows:
   1. Maximum calculated deflection of 7.5%
   2. Live loads as calculated per AWWA M23 based on the profile shown on the plans
   3. Depth of cover as shown on the plans
   4. Trench width as shown on the plans
   5. Modulus of soil reaction (E'), bedding constant (K), and soil density (γ) shall be based on design and site conditions.

2.3 FITTINGS:

A. Fittings shall be manufactured and supplied in accordance with ASTM D3034 (4-Inch to 15-Inch) or ASTM F679 (18-Inch to 60-Inch). Molded and fabricated fittings may be supplied in accordance with ASTM F1336.

B. Fittings shall be made of PVC compound having a cell classification of 12454 or 13343 in accordance with ASTM D1784.

C. Pipe used in fabricated fittings shall have a wall thickness equal to or greater than the wall thickness of the pipes to which the fitting (or that part of the fitting) will be joined.

D. Molded and fabricated fittings shall have markings including:
   1. Manufacturer's name or trademark
   2. Nominal size
   3. Material designation (e.g. "PVC")
   4. ASTM Designation

E. Fittings may also be supplied as ductile iron fittings in accordance with AWWA C110 and/or C153.

2.4 PIPE JOINTS:

A. Joints shall be gasketed push-on type conforming to ASTM D3212.

B. Gasket materials shall meet requirements of ASTM F477.

C. Joint lubricant shall be approved by the Pipe Manufacturer and shall have no detrimental effect on the gasket or pipe.

PART 3 – EXECUTION

3.1 GENERAL:

A. Install pipe, fittings, specials, and appurtenances in accordance with ASTM D2321, UNI-PUB-6 and/or in accordance with the Pipe Manufacturer's recommendations.

B. Lay pipe to the lines and grades as indicated on the Plans.

3.2 PIPE HANDLING:

A. Handle pipe and piping materials with care to avoid damage.

B. Prior to installation, each pipe length shall be carefully inspected for damage.

C. All pipe, fittings, and appurtenances shall be thoroughly cleaned before installation and shall be kept clean until installation and backfilling has been completed.

D. Use only nylon ropes, slings, or other lifting devices that will not damage the surface of the pipe.

E. Keep the pipe clean and free of debris, dirt, animals, and trash during and after laying operations.

F. At the close of each operating day, seal the open end of the pipe using a gasketed night cap.

3.3 PIPE INSTALLATION:

A. Do not drag pipe over gravel or rock. Avoid striking rocks or hard objects when lowering pipe into the trench.

B. Placement of pipe and fittings into the trench should be done with ropes and skids, slings on a backhoe bucket, or by hand.

C. Pipe or fittings shall not be thrown into the trench and no part of the pipe shall be allowed to take an unrestrained fall onto the trench bottom.

D. Joint sockets shall be carefully cleaned before pipes are lowered into trenches.

E. Pipe trenches and excavation shall be kept free of water during pipe laying operations and other related work. If high groundwater levels are expected or encountered, Contractor is to ensure that a minimum depth of cover of 1.5 times the pipe diameter will be maintained over the pipe once it has been installed or provide other methods approved by the Owner and Pipe Manufacturer of preventing flotation of the pipe.

3.4 JOINT MAKING:

A. Install push-on joints in accordance with Pipe and Fittings Manufacturer's recommendations.

B. Inspect the gasket, pipe spigot bevel, gasket groove, and sealing surfaces for damage or deformation. In cases when gaskets are supplied separately from pipe, Contractor is to ensure that gaskets supplied are designed for the pipe in use.

C. Clean the gasket of all extraneous matter.

D. Apply a thin film of joint lubricant to the inside of the gasket and the outside of the spigot prior to entering the spigot into the bell. Lubricated spigots ends shall not come in contact with soil or backfill material.

E. Insert the spigot end of the pipe carefully into the bell until the reference mark on the spigot is flush with the bell. If two reference marks are present, the mark closest to the spigot end shall be considered the minimum insertion mark, and the second mark shall be considered the maximum insertion mark. Under no circumstances will the spigot be inserted into the bell past the reference mark or maximum insertion mark.

F. For small diameter pipe, use the bar-and-block method for joint assembly or other method approved for use by the Owner and Pipe Manufacturer.

G. For large diameter pipe, use mechanical assistance such as hydraulic pipe pullers, jacks, pulleys, come-alongs, or a backhoe bucket. Observation by a spotter will be required when assembling joints for large diameter pipe to prevent over-insertion.

H. When using a field cut plain end piece of pipe, bevel the end with a beveling tool, wood rasp, or power sander to the same angle and length as provided on the factory-finished pipe. Redraw the insertion line on the spigot using a factory-marked spigot as a guide.

I. Angular changes in pipe alignment shall be achieved by either fittings, joint deflection, or longitudinal bending of the pipe.

J. Joint deflection shall not exceed the Pipe Manufacturer's recommendation.

K. Field assembly of pipe fittings shall follow the Pipe Fittings Manufacturer's recommendations.

L. Mechanical joints shall be assembled per the Pipe and/or Fittings Manufacturer's recommendations as well as the recommendations of the mechanical joint supplier.

3.5 LONGITUDINAL PIPE BENDING:

A. Controlled changes in direction may be accomplished by longitudinal bending of the pipe barrel.

B. Pipe Manufacturer shall be consulted prior to start of construction for recommendations on longitudinal bending.

C. When longitudinal bending of pipe is utilized, Contractor shall use manual force alone to achieve prescribed bending. Mechanical means shall not be utilized to achieve longitudinal bending of the pipe.

D. When the desired change of direction in the pipeline exceeds the maximum allowable deflection specified, the longitudinal bending shall be made throughout a number of pipe lengths.

E. Contractor will ensure that pipe joints will not be over-pulled or over-inserted during longitudinal bending operations.

3.6 FIELD TESTING:

A. After pipe has been installed and backfilled, deflection testing shall be performed in accordance with ASTM D3034 and/or F679, PVC Pipe Handbook, and the specifications herein. Deflection testing shall utilize a "go/no-go" mandrel for measurement of pipe deflection. Contractor shall allow for stabilization of the pipe/soil system (minimum of 30 days) prior to testing.

B. All finished installations for non-pressure applications shall be tested via low-pressure air testing in accordance with ASTM F1417, UNI-B-6, and the specifications herein.

C. Isolate the section of non-pressure sewer line to be air tested by inflatable stoppers or other suitable test plugs/caps.

D. Ends of all branches, laterals, tees, wyes, and/or stubs in the test section shall be plugged or capped to prevent air leakage. One of the plugs/caps shall have an inlet tap or other method for connecting the air hose to an air control source.

E. Test ends should be restrained and/or braced during air testing.

F. Add air slowly to the test section until the pressure reaches 4.0 psi. After the test pressure is obtained, regulate the air supply so that the pressure is maintained between 3.5 and 4.0 psi for at

least 2 minutes until the air temperature stabilizes and is in equilibrium with the temperature of the pipe walls.

G. After equilibrium is achieved, determine the rate of air pressure loss by either the constant pressure method or the time-pressure drop method as outlined in ASTM F1417.

H. Upon completion of the test, open the bleeder valve and allow all air to escape. Caps/plugs shall not be removed until all air pressure in the test section has been reduced to atmospheric pressure.

PART 4 - MEASUREMENT AND PAYMENT:

4.1 MEASUREMENT:

A. Measurement shall be made on the basis of lineal foot of PVC sewer pipe of the type and size(s) properly placed, as measured by the Engineer. Measurements shall be made horizontally along the axis of the pipe and shall include all fittings and/or accessories not specifically included for measurement and payment under other items in the Proposal.

4.2 PAYMENT:

A. Payment will be made at the unit price bid under the appropriate item(s) of the Proposal; the price bid shall include ,excavation, shoring, dewatering, disposal, bedding, NYSDOT sub-base backfill, compaction, compaction testing, thrust blocks, retaining rods, fittings and specials, including reducers, disinfection, testing and sampling, restoration; identification tape, locating wire, record drawings, miscellaneous work, including connection to existing mains and appurtenances, abandonment of existing mains, as required to complete the work.

B. Where no payment items is provided in the Contract proposal, and PVC sewer pipe is necessary or required for the work, no separate payment will be made and such material, in place, shall be deemed included in other payment items of the proposal.

END OF SECTION 330531.11

SECTION 330598 - TRACER WIRE

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Provide tracer wire (locating wire) and accessories for all non-metallic mains.

1.2 RELATED DOCUMENTS:

A. Trenching, Backfilling and Compaction Work – Section 312333

B. Polyvinyl Chloride (PVC) Pipe for Non-Pressure Sewer Service – Section 330531.11

C. Polyvinyl Chloride (PVC) Pipe for Pressure Sewer Pipe – Section 333113

D. Polyvinyl Chloride (PVC) Pipe for Water Service – Section 331113.23

1.3 REFERENCES:

A. ASTM D1248 – Polyethylene Plastic Extrusion Materials for Wire and Cable

1.4 QUALITY ASSURANCE

A. Provide tracer wire designed specifically for detecting buried facilities.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Tracer Wire:

1. Standard of Quality: Design is based on products of Copperhead Industries <http://www.copperheadwire.com>.
2. Other acceptable Manufacturers: Subject to compliance with specified requirements, acceptable manufacturers and products are:
   a. Manufacturer of comparable products submitted in compliance with Section 013300 – Submittal Procedures.

B. Connectors:

1. Standard of Quality: Design is based on Snakebite Locking Connectors by www.copperheadwire.com.
2. Other Acceptable Manufacturers: Subject to compliance with specified requirements.
3. Hydrant tracer wire bracket with PVC conduit.

C. Tracer Wire Access Box:

1. Valvco: Part SEWAB
2. Copperhead Lite-Duty Tracer Wire Access Box (LD14*TP) in grass areas at hydrant locations.
3. Copperhead Concrete Driveway Box (CD14*TP) for sidewalks and driveways with light traffic.
4. Copperhead Roadway Box (RB14*TP) for gate valves and manholes in streets and parking lots with heavy traffic.

2.2 MATERIALS:

A. Open Trench/Boring Installation:

1. Direct burial 12 AWG solid, CCS (Copper Clad Steel), 0.171-inch diameter; boring 8 AWG solid, CCS (copper clad steel) 0.219-inch diameter
2. Steel core high strength for direct burial, with a rated break load of 1,330 pounds and for boring installation a rated break load of 2,785 pounds.
3. 0.045-inch high molecular weight, high-density polyethylene, complying with ASTM D1248.
4. High flexibility, stretchable to accommodate ground movement.
5. Impact resistant.
6. 30-volt rating.
7. Jacket color: Green - "Sewer"; Blue - "Water", Purple - "Reclaimed Water/ Irrigation"
8. Physical, permanent, surface legend on insulating jacket, repeated a minimum of every 2 linear feet.
9. For directional boring 2-8 AWG tracer wires shall be installed with the pipe and connected to the tracer wire at both ends.

B. Connectors:

1. Waterproof and corrosion proof.
2. Prefilled with non-hardening sealant.
3. Lug:
   a. Tin plated high conductivity aluminum with high impact polypropylene housing.
   b. Product: Snakebite Locking Connectors.
4. Connectors:
   a. CSA certified as both Pressure Type and Direct Bury.
   b. Product: Copperhead Wire.

C. Magnesium Anode
1. Provide 5-pound anode at each:
   a. Hydrant
   b. Every Other Manhole
   c. Connection to existing facilities

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Approved spliced connection locations: fire hydrant and manhole discharge connections to the main.

B. Except for approved splice connections and repairs, install in continuous manner from discharge manhole to flushing connection, from hydrant to hydrant and manhole to manhole.

C. Install tracer wire parallel with centerline axis of pipe and at "3 o'clock" position.

1. Do not spiral wrap wire to pipe.
2. Do not install under service saddles.
3. Tape tracer wire to pipe.

D. Terminate tracer wires in accordance with Drawings.

1. Terminate in tracer wire access box at each fire hydrant, air release manhole, sanitary manhole, flushing connection and discharge manhole.
2. Provide minimum 3-foot long pigtail at grade termination points within tracer box.
3. Provide 5-pound magnesium anode a maximum of every 1000 feet and at buried pipe ends:

    a. Attach to the main tracer wire by solder.
    b. Remove anode protective cover.
    c. Apply water as directed by manufacturer.

3.2 FIELD QUALITY CONTROL:

A. System Testing:

1. Test continuity of conduction in the presence of the Engineer.
2. Connect signal generator at wire termini and trace signal throughout the installation.
3. Locate and repair all breaks in conductivity.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT:

A. Measurement shall be made on the basis of lineal foot of pipe of the type and size(s) properly placed, as measured by the Engineer. Measurements shall be made horizontally along the axis of the pipe and shall include all fittings and/or accessories not specifically included for measurement and payment under other items in the Proposal.

4.2 PAYMENT:

A. Payment will be made at the unit price bid under the appropriate item(s) of the Proposal.

END OF SECTION 330598

SECTION 331050 – POLYETHYLENE PRESSURE PIPE

PART 1 – GENERAL

1.1 SUMMARY:

A. This specification covers the material (pipe and fittings), joining methods and general installation practice for high density polyethylene pipe (HDPE) piping systems for use as indicated on the Drawings.

B. Furnish all labor, materials, equipment, and incidentals required to install High Density Polyethylene (HDPE) pressure pipe, fittings, and appurtenances as shown on the Drawings and specified in the Contract Documents.

1.2 REFERENCE STANDARDS:

A. ANSI/AWWA C901 Polyethylene (PE) Pressure Pipe and Tubing, 3/4 in. (19 mm) Through 3 In. (76 mm) for Water Service

B. ANSI/AWWA C906 Polyethylene (PE) Pressure Pipe and Fittings, 4 in. Through 65 in. (100 mm Through 1,650 mm) for Waterworks

C. All standard specifications, i.e., Federal, ANSI, ASTM, etc., made a portion of these Specifications by reference, shall be the latest edition and revision thereof.

D. ASTM F2880 Standard Specification for Lap-Joint Type Flange Adapters for Polyethylene Pressure Pipe in Nominal Pipe Sizes 3⁄4 in. to 65 in.

E. ASTM D2683 Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter- Controlled Polyethylene Pipe and Tubing

F. ASTM D3261 Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

G. ASTM D3350 Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

H. ASTM F714 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter

I. M F2164 Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure

J. ASTM F2206 Standard Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE)

K. ASTM F2620 Standard Practice for Heat Fusion Joining Polyethylene Pipe and Fittings

L. ASTM F3124 Standard Practice for Data Recording the Procedure Used to Produce Heat Butt Fusion Joints in Plastic Piping Systems or Fittings

M. ASTM F3183 Standard Practice for Guided Side Bend Evaluation of Polyethylene Pipe Butt Fusion Joint

N. ASTM F3190 Standard Practice for Heat Fusion Equipment (HFE) Operator Qualification on Polyethylene (PE) and Polyamide (PA) Pipe and Fittings

O. ANSI/AWWA C651 Standard for Disinfecting Water Mains

1.3 RELATED SECTIONS

A. Section 333213 - Plant Water Pump Station

B. Section 330110.13 - Pressure And Leakage Testing Of Pipelines

C. Section 331301 – Disinfection Testing of Pipelines

D. Section 330598- Tracer Wire

1.4 SUBMITALS

A. Submit to the Engineer, a list of materials to be furnished, the names of the suppliers, and the appropriate shop drawings for all HDPE pipe and fittings.

B. Submit the pipe manufacturer's certification of compliance with the applicable sections of the Specifications.

C. Submit shop drawings showing installation method and the proposed method and specialized equipment to be used

D. Details of fittings and specials such as elbows, tees, outlets, connections, test bulkheads, nozzles or other special items where shown on the Construction Drawings. All connections to jointed gasketed pipe materials, valves or fire hydrants must be restrained and supported independently to withstand the pressure transients, soil settlement, and external loading conditions.

PART 2 – PRODUCTS

2.1 MANUFACTURER

A. All Pipe, Fittings, and Fusion Equipment shall be provided by one supplier. Approved suppliers are:

1. ISCO Industries, Inc.
2. JM Eagle
3. Or Approved Equal

2.2 BASIS OF DESIGN

A. MATERIAL

1. Materials used for the manufacturing of polyethylene pipe and fittings shall be PE 4710 High Density Poly- ethylene (HDPE).

2. The Manufacturer shall certify that the materials used to manufacture pipe and fittings meet the requirements of this specification.

3. All HDPE piping and fittings shall meet all pressure classifications and ratings per the requirements of AWWA C906 and AWWA C901 outlined in Table 1.

TABLE 1: PE 4710 Preferred Pressure Classes per AWWA C906 and AWWA C901

Pipe Dimension Ratio (DR)	Pressure Class / Rating (psi)	Allowable Total Pressure during Recurring Surge (psi)	Allowable Total Pressure during Occasional Surge (psi)	Allowable Hydrotest (Field) Pressure (psi)	AWWA C906 and AWWA C901
DR-11	200	300	400	300	YES
DR-9	250	375	500	375	YES

B. PIPE

1. Pipe sizes 3" DIPS/4" IPS and larger shall have a manufacturing standard of ASTM F714, while IPS pipe 3" and smaller shall be manufactured to the dimensional requirements listed in ASTM D3035. Dimension Ratio (DR) and Outside Diameter (IPS/DIPS) shall be as specified on plans.

C. IDENTIFICATION

1. Color Identification: HDPE must have at least three equally spaced horizontal colored marking stripes. Permanent identification of piping service (for it's applicable use) shall be provided by adhering to the following colors:
    a. White – raw water
    b. Green – wastewater, sewage
    c. Pantone Purple – non-potable irrigation, reclaimed or reuse water
    d. Blue – potable water

D. FITTINGS

1. Polyethylene fittings shall be made from material meeting the same requirements as the pipe. Polyethylene fittings shall be molded or fabricated by the manufacturer of the pipe.
2. Where applicable, fittings shall meet the requirements of AWWA C906.
3. Molded fittings shall be manufactured in accordance with either ASTM D2683 (socket fused) or ASTM D3261 (butt fused) and shall be so marked.
4. Polyethylene Flange Adapters: Flange adapters shall be made with sufficient through-bore length to be clamped in a butt fusion joining machine without the use of a stub-end holder. The sealing surface of the flange adapter shall be machined with a series of small v-shaped grooves to provide gasketless sealing, or to restrain the gasket against

blow-out.

5. Back-up Rings and Flange Bolts: Flange adapters shall be fitted with lap joint flanges pressure rated equal to or greater than the mating pipe. The lap joint flange bore shall be chamfered or radiused to provide clearance to the flange adapter radius. Flange bolts and nuts shall be Grade 2 or higher.

2.3 MANUFACTURER' S QUALITY CONTROL

A. The pipe and fitting manufacturer shall have an established quality control program responsible for inspecting incoming and outgoing materials. Incoming polyethylene materials shall be inspected for density, melt flow rate, and contamination. The cell classification properties of the material shall be certified by the supplier and verified by Manufacturer's Quality Control. Incoming materials shall be approved by Quality Control before processing into finished goods. Outgoing materials shall be checked for the following:

1. Outside diameter, wall thickness and eccentricity
2. Out of roundness
3. Straightness, inside and outside surface finish, markings and end cuts
4. Density, Melt Index, Carbon Conten, Quick Burst Pressure, and Ring Tensile Strength.

PART 3 – EXECUTION

3.1 TRAINING AND INSPECTION

A. Refer to ASTM F3190, ASTM F1290, MAB-01and MAB-02 for recommended training and inspection for butt-fusion, socket fusion and Electrofusion joints. All equipment shall be inspected and personnel training requirements completed and verified prior to commencing construction. Each fusion technician shall be qualified to specifically make the required fusion joint; qualification shall be demonstrated by evidence of training within one year on the equipment and pipe size(s) to be utilized for this project.

3.2 JOINING METHODS

A. The pipe and fittings shall be joined by butt fusion or electrofusion couplings, mechanical joint (MJ) adapters, or by flange connections in accordance with manufacturer's recommendations and as required in this document. Unless otherwise shown on Drawings and except for connections to existing utilities, all joints shall be fused.

B. Butt Fusion: The pipe shall be joined by heat fusion of the ends. Prior to fusion the pipe shall be clean and the ends shall be cut square. Butt-fusion joining is applicable to pipes that have the same nominal outside diameter and wall thickness, within one SDR. Field site butt-fusion system operators shall be trained in the use of the high quality butt-fusion equipment that secure and precisely align the pipe ends for the fusion process. Operators shall be trained by the pipe supplier or manufacturer of the fusing machine and be experienced in the operation of the equipment. Fusion quality shall be recorded, the recording of the information must be provided to the Owner. The Owner will review documents within 7 days and identify any fusion records that might indicate the need to replace an existing fused connection. The 9 recorded fusion information must meet the standard requirements of ASTM F3124. All fusions failing to meet these requirements shall be removed and refused. Refer to ASTM F2620, ASTM F3124, ASTM F3183 and ASTM F3190.

C. Saddle fusion: Saddle fusion shall be done in accordance with ASTM F2620 or TR-41 or the fitting manufacturer's recommendations and PPI TR-41. Saddle fusion joints shall be made by qualified fusion technicians. Qualification of the fusion technician shall be demonstrated by evidence of fusion training within the past year on the equipment to be utilized on this project. [Saddle fusion is used to fuse branch saddles, tapping tees, and other HDPE constructs onto the wall of the main pipe] (ASTM F905).

D. Socket Fusion: Molded socket fusion fittings are only to be used for joining of HDPE pipe from ¾ inch to 2 inch size. Socket fusion shall be done in accordance with ASTM F2620 or the fitting manufacturer's recommendations. Socket fusion is the process of fusing pipe to pipe, or pipe to fitting by the use of male and female ends that are heated simultaneously, and pressed together so the outside wall of the male end is fused to the inside wall of the female end. Qualification of the fusion technician shall be demonstrated by evidence of socket fusion training within the past year on the equipment to be utilized on this project.

E. Mechanical connection of HDPE to auxiliary equipment such as valves, pumps, and fittings shall use flanges or mechanical joint adapters and other devices in conformance with the PPI Handbook of Polyethylene Pipe, Chapter 9 and AWWA Manual of Practice M55, Chapter 6. Mechanical connections shall be manufactured for HDPE pipe and approved by the connection manufacturer for use with polyethylene pipe. Flanges and MJ adaptors should be double checked for butterfly valve clearance to allow full disc rotation and movement prior to installation in the trench. Uncontrolled tapering or hand-beveling in the field is not allowed.

F. Mechanical connections on pipe 3” and smaller are available to connect HDPE pipe to other HDPE pipe, or a fittings, or to a transition to another material. The use of stabfit style couplings is allowed, along with the use of metallic couplings of brass and other materials. All mechanical and compression fittings shall be recommended by the manufacturer for use with HDPE and with potable water. Refer to fittings manufacturers and to Polyethylene Piping Systems Field Manual for Municipal Water. Manufactured transition fittings are also available.

G. Mechanical couplings that wrap around the pipe and act as saddles are made by several manufacturers specifically for HDPE pipe. All such saddles, tapping saddles, couplings and clamps shall be recommended by the manufacturer as being designed for use with HDPE pipe at the required pressure class (Section 1.4); all mechanical couplings shall be fully restrained either by themselves or by an alternate means.

H. Mechanical Joint/Flange: A flange assembly consists of a metal back-up flange or bolt-ring and a polyethylene flange adapter. MJ assembly consists of a MJ adaptor with gland ring, gasket and bolt kit. Both MJ adapters and flange adapters are fused onto the plain end of the pipe main. Bolting guidance for MJ connections is provided in AWWA C600 and guidance for flanges and gaskets is provided in PPI-TN38. Note that an HDPE flange adapter acts as both a flange and a gasket, and as such, no ‘gasket’ is required. For further information, refer to PPI TN38.

3.3 INSTALLATION

A. Joints between plain ends of polyethylene pipe shall be made by butt fusion when possible. The Pipe Manufacturer’s fusion procedures shall be followed at all times as well as the recommendations of the Fusion Machine Manufacturer. The wall thicknesses of the adjoining pipes shall have the same DR at the point of fusion
B. When saddle connections are fusion welded the Manufacturer’s recommended saddle fusion procedures shall be used.
C. If mechanical fittings (which are designed for or tested and found acceptable for use with polyethylene pipe) are utilized for transitions between pipe materials, repairs, joining pipe sections, saddle connections, or at other locations, the recommendation of the Mechanical Fitting Manufacturer must be followed.
D. Install all high-density polyethylene (HDPE) pressure pipe by direct bury, directional bore, or a method approved by the Engineer prior to construction. If directional bore is used, or if directed by the Engineer, surround the entire area of construction with silt barriers.
E. Install all high-density polyethylene pressure pipe and fittings in accordance with Manufacturer's recommendations, and this specification. Take all necessary precautions

to ensure a safe working environment in accordance with the applicable codes and standards.

3.4 OPEN TRENCH INSTALLATION:

A. Install the piping system in accordance with the engineering drawings and ASTM D2774 or AWWA M55. Place and compact the embedment and backfill soils with the guidelines in ASTM F1668. Deviations shall be approved by the Engineer.

B. Take care when placing, moving, or removing the trench boxes, sheeting or shoring, or bracing to prevent disturbance of the pipe and the embedment soils. Any voids or disturbance shall be refilled and re-compacted.

C. Per AWWA M55, "ANSI/AWWA C906 PE pressure piping systems must be installed with fully restrained joints or with partially restrained joints AND external joint restraints.

D. ANSI/AWWA C906 pressure piping systems that are joined by heat fusion, electrofusion, flanges, and MJ adaptors are fully [self-] restrained and do not require external joint restraints or thrust block joint anchors." Concrete embedded HDPE thrust anchors should be considered prior to connections to unrestrained pipes. Refer to AWWA M55 for design guidance.

E. Joining Methods. Refer to Section 2.2 for details

F. Water Mains and Accessories. HDPE connections to other pipe materials or valves and fire hydrants shall be made by mechanical joints, flanges or transition fittings. All connections to jointed gasketed pipe materials, valves or fire hydrants must be restrained and supported independently.

G. Restrained Mechanical Joints: Restrained mechanical joints shall be made using mechanical joint adapters. Refer to the manufacturer's instructions on the need for stiffeners when installing a mechanical joint.

H. Flange connections shall be as described in Section 3.3

I. Refer to Section 330598- Tracer Wire for installation of wire where applicable.

3.4 APPURTENANCES

A. All appurtenances (tees, elbows, services, valves, air relief valves, fire hydrants, etc.), must be independently supported and shall not rely on the pipeline and its connections for this support. Excessive stresses may be encountered when appurtenances are inadequately supported.

B. Hydrant Assemblies shall be installed and field tested according to the requirements of AWWA M17

3.5 TESTING

A. Socket and Saddle fusions shall be tested by a bent strap test as described by the Pipe Manufacturer. The pipe Manufacturer shall provide visual guidelines for inspecting the butt, saddle, and socket fusion joints.
B. Pressure testing shall be conducted in accordance with the Manufacturer's recommended procedure. Pressure testing shall use water as the test media. Pneumatic (air) testing is prohibited.
C. Hydrostatic testing shall be in accordance with Section 330110.13 Pressure and Leakage Testing of Pipelines.

3.6 CLEANING AND DISINFECTION

A. Cleaning and disinfecting of potable water systems shall be in accordance with AWWA C651 and AWWA M55 Chapter 10.

E. Refer to Section 331301 Disinfection Testing of Pipelines for more information for potable water pipes only.

END OF SECTION 331050

SECTION 331113.13 DUCTILE IRON (D.I.) WATER PIPE AND SPECIALS (NY)

PART 1 – GENERAL

1.1 WORK INCLUDED:

A. Provide and install ductile cast iron pressure water pipe and specials, with end types (mechanical joint, flanged, push-on or ball and socket) as called for or shown with integral wall bell and spigot joints.

1.2 RELATED WORK:

A. Trenching, Backfilling and Compaction - Section 312333

B. Pressure and Leakage Testing of Pipelines – Section 330110.13

C. Disinfection Testing of Pipelines – Section 331301

1.3 EXISTING CONDITIONS:

A. It shall be the Contractor's responsibility to investigate all site conditions that may affect his work.

PART 2 – MATERIALS

2.1 PIPE (GENERAL):

A. All pipe shall be centrifugally cast.

B. Shall be coated on the outside and cement-lined.

C. Shall be in nominal eighteen (18) feet laying lengths, according to the Manufacturer's standard practice.

D. Shall be Class 52, unless otherwise indicated, suitable for a working pressure of 350 psi.

E. The weight, class or nominal thickness and casting period shall be shown on each pipe.

F. The manufacturer's mark, the year in which the pipe was produced and letters "DI" or "Ductile" shall be cast or stamped on each pipe.

2.2 DEFINITIONS:

A. "Pipe" - all straight sections

B. "Specials" - all branches, bends, tees, other fittings, reducers, etc.

C. Straight pipe which is cut to fit to work, or short sections of straight pipe, will not be considered specials.

D. All cast iron specials shall be Class 250, shall have the same type ends and shall be in accordance with the Specifications for the pipe with which they are to be placed unless specifically indicated otherwise.

2.3 PIPE (JOINTS AND FITTINGS):

A. Mechanical Joint Pipe:

1. Joint shall meet all requirements of American standard Specifications for Mechanical Joints, A21.11 "year of latest revision".
2. Shall have the same pressure rating as the pipe of which it is part.
3. Bell of mechanical joint shall be cast integrally with the pipe and shall meet the applicable requirements of the specifications under which the pipe is produced.
4. The iron in the glands shall meet the requirements of Class 25 of American Standard Specifications for gray iron cast, ASA G25.1, or most recent revision thereof.
5. The annular surfaces of the gland lip and the bolt circle, shall be concentric and tolerances shall be given by the American Standard Specifications for Mechanical Joints, A21.11 - 1964, or "year of latest revisions".
6. The surface of the gland shall be smooth and free from defects of every nature which would unfit them for the use intended.
7. Glands shall be coated with a bituminous dip or paint, unless otherwise specified.
8. Gaskets shall be vulcanized natural or vulcanized synthetic rubber and shall be in accordance with American Standard Specification A21.11 "year of latest revision". No reclaimed rubber shall be used. When two (2) hardnesses of rubber are included in a gasket, the soft and hard portions shall be integrally molded and joined in a strong vulcanized bond. They shall be free of porous areas, foreign material, and visible defects. Tests shall be made by the manufacturer in accordance with the applicable ASTM Test Methods. Gaskets shall be Rainbow, Durable, Garlock or "approved" equal.
9. The mechanical joint for ductile iron pipe shall meet all the requirements of the American Standard Specifications for Mechanical Joints A21.11 "year of latest revision", and shall have the same pressure rating as the pipe of which it is a part.

B. Push-on Joint Pipe:

1. Joint shall meet all requirements of ANSI A21.11 "year of latest revision" (AWWA C111) for the rubber gasket joints.
2. All joints shall be provided with two (2) serrated bronze wedges at the 10 o'clock and 2 o'clock positions in accordance with the pipe manufacturer's standards. Wedges shall insure electrical conductivity throughout the entire length of pipeline.

C. Flanged Pipe (Only utilized where specifically called for or required):

1. To be provided where specifically indicated on the Plans or called for in the Specifications.

2. Shall be of the water pattern, as under American Standard Association Specification 3.6.1, Class 125 or Class 250 (as indicated), latest revision.
3. Shall conform to ANSI A21.10 (latest revision).
4. All flanged pipe ends and fittings shall be faced and drilled in accordance with the aforementioned standard.
5. The gasket material, bolts and nuts, and all other items necessary to provide a complete installation of flanged pipe and fittings shall be provided and included.

D. Ball and Socket (Only utilized where specifically called for or required):

1. To be provided where specifically indicated on the Plans or called for in the specifications.
2. Shall be suitable for usage on the water system shown.
3. Joints shall be boltless, push-on, with bayonet-type locking retainer and capable of deflections to a maximum of 5 degrees.
4. Joint bell, ball and retainer shall be of cast 70-50-05 ductile iron in accordance with ANSI A21.20 (year of latest revision).
5. Pipe components shall be machined to precise tolerances to assure premium performance and ease of assembly.
6. Gasket shall be of high quality rubber and symmetrical to insure it cannot be installed backwards.
7. Pipe shall be ductile iron of cast 60-42-10 in accordance with ANSI A21.51.
8. Pipe shall be of the thickness class number to overcome buoyancy.
9. Pipe shall be cement-lined, bituminous coated, 18' lengths and conform to all other requirements under this section, unless otherwise noted.

2.4 STANDARDS:

A. All pipe and fittings shall at minimum meet all the applicable requirements of the American Water Works Association (AWWA) as well as the Standard Design and Construction Requirements for Water Distribution Main Extensions for the Town of New Windsor Consolidated Water District.

B. Pipe shall conform to American National Standard for Ductile Iron Pipe, Centrifugally Cast in Metal Molds, for the water or other liquids of AWWA Specifications C151, year of latest revision.

C. All the ductile cast iron pipe and fittings shall be cement-lined in accordance with "American Standard Specifications for Cement Mortar Lining for Cast Iron Pipe and Fittings, A21-4 "year of latest revision" or AWWA C104.

D. Bituminous seal coat shall be applied over the cement lining as specified in A.S.A. Specification A21.4 "year of latest revision.

PART 3 - CONSTRUCTION DETAILS

3.1 GENERAL:

A. All pipe must be installed in accordance with AWWA Standard C600, year of latest revision, as defined in 10 NYCRR 5-1.22(a).

B. All pipe and fittings shall be placed as shown on the plans and in compliance with the requirements of the specifications.

C. All pipe shall be installed and assembled in accordance with the manufacturer's recommendations.

D. All materials used in the construction shall be lead free in accordance with the 2014 “Lead Free” law.

3.2 INSPECTION OF PIPE:

A. Previous to being lowered into the trench, each pipe and fittings or coupling shall be carefully inspected, and those not meeting the specifications shall be rejected and immediately removed from the project site and replaced with acceptable materials. Such replacement shall be made at no cost to the Owner.

B. Movement of construction equipment and all other vehicles and loads over and adjacent to any pipe shall be done at the Contractor's risk. Any pipe, which in the judgement of the Engineer is damaged or disturbed through any cause, shall be replaced at the expense of the Contractor and at no cost to the Owner.

3.3 PIPE PLACEMENT (GENERAL):

A. Pipe lines shall be placed in the locations and grades as indicated on the Plans and in conformance with this Specification.

B. Trenches shall be kept free from water, and no pipe shall be laid in water.

C. Every effort shall be made to prevent any contaminating materials from entering the watermain during storage, construction or repair.

D. Pipe shall be so laid as to be evenly supported throughout the whole length of the barrel, with no weight resting on the bell or coupling. "Bell holes" shall be provided so that bells or couplings of pipe hang free.

E. If the trench is dug deeper than the grade of the barrel, no spalls, shims or lumps shall be used to raise the pipe to the grade, but an even bed shall be formed of sand or accepted fine material properly tamped at no additional expenses to the Owner.

F. In all cases where piping is being installed below the ground surface, before leaving the work for the night or any other time, the end of the pipe shall be securely closed with a watertight tight-fitting plug, and sufficient backfilling placed to protect the pipe.

G. When pipe is under pressure, and as indicated by the Engineer, reaction or thrust blocks shall be applied on all pipe lines size four (4) inches in diameter or larger at all tees, plugs, caps, and joints deflecting 22-1/2 degrees or more.

H. Tie rodding shall be done using pipe clamps manufactured for this purpose with minimum of 2-3/4" diameter steel rods. Thrust blocks shall be provided for any bends 22-1/2 degree or greater. Thrust blocks shall comply with the details shown on the plans (if no such details are shown, dimensions

shall meet Engineer's requirements). All costs of furnishing and placing such thrust blocks or tie rods shall be at the expense of the Contractor, and shall be included in the price bid under these items.

3.4 PIPE PLACEMENT (FOUNDATION):

A. All pipe shall be laid on a foundation of compacted Crushed Stone Foundation to the minimum dimensions noted on the detail on the Plans.

B. If in the opinion of the Engineer the subgrade will not properly support the pipe, additional crushed stone materials shall be provided as necessary to provide a firm pipe bedding as acceptable to the Engineer.

C. Ground conditions such as quick sand, other soft and yielding or otherwise unsuitable material shall be immediately brought to the Engineer's attention such that evaluation of the necessary bedding can be made.

D. The Contractor is advised that additional crushed stone foundation material shall only be placed where required for the Engineer's acceptance of the work.

E. All Crushed Stone Foundation material shall conform to the requirements of the applicable technical section of the Specifications.

3.5 PIPE PLACEMENT (LOCATION & GRADE):

A. The pipe or invert grade referred to in the specifications and as indicated on the plans is the lowest point of the pipe invert or flow line.

B. Pipe shall be placed in the location and at exactly the lines and grades indicated on the plans.

C. The Engineer shall have the power to require the removal or relaying of any pipe laid contrary to the plans during his absence or that of his assistants or the Project Representative from the project site.

D. Grade or alignment shall not be disturbed by the operation of tamping or backfilling. Care must be taken not to disturb the pipes by stepping on or near them, or by throwing earth on them from the bank or otherwise.

E. The pipes and fittings or couplings shall be so laid in the trench that after the line is completed the interior surface thereof shall conform accurately to the grade and line required by the Engineer, and as indicated on the plans.

F. Contractor must transfer line and grade to "batter boards" and string line over the trench. The Contractor may not transfer line and grade to and/or utilize a "side line" or string set to line and grade other than over and above the center line of the pipe to be laid.

G. Other methods of Grade and Alignment control are subject to acceptance by the Engineer.

3.6 PIPING JOINTS:

A. Mechanical:

1. Joints shall be installed in full conformance with the manufacturer's recommendations.
2. Spigot end of the pipe shall be thoroughly brushed with a wire brush and then the gasket and spigot end of the pipe shall be brushed with soapy water. Cast iron gland shall then be slipped on the spigot end of the pipe with lip extension toward the joint. The gasket shall then be slipped on with the thick edge of the gasket toward the gland. The bell end of the joint shall then be thoroughly brushed and the pipe inserted into the bell. The gasket shall then be pushed into position so that it is evenly seated in the socket of the bell. The gland shall then be moved into position against the face of the gasket. Bolts shall then be inserted, the nuts placed, and made up tightly with the fingers. Nuts shall then be tightened gradually, half turn at a time, using a torque-limited wrench of suitable size for the bolt sizes used, moving it from one nut to another and repeating until all nuts are uniformly tight. Torque limits of the bolts shall be in accordance with the pipe manufacturer's recommendations.

B. Push-On:

1. Joints shall be installed in full conformance with the manufacturer's recommendations.
2. The inside of the bell and outside of the spigot end shall be thoroughly cleaned and to remove oil, grit, excess coating and other foreign matter. The circular rubber gasket shall be flexed inward and inserted in the gasket recess of the bell socket. A thin film of gasket lubricant shall be applied to either the inside surface of the gasket or the spigot end of the pipe, or both. Gasket lubricant shall be as supplied by the pipe manufacturer and accepted by the Engineer. The spigot end of the pipe shall be entered into the socket with care used to keep the joint from contacting the ground. The joint shall then be completed by forcing the plain end to the bottom of the socket with a forked tool or jack-type tool or other device acceptable to the Engineer. Pipe that is not furnished with a depth mark shall be marked before assembly to assure that the spigot end is inserted to the full depth of the joint. Field cut pipe lengths shall be filed or ground to assemble the spigot end of such pipes as manufactured. Assemble instructions of the manufacturer shall be followed where not in conflict with the foregoing.

3.7 DISINFECTION:

A. All elements of water line construction installed or disturbed under this contract when complete, shall be disinfected in accordance with these specifications, all applicable requirements of the local, county and state health department and AWWA Standard C651 (latest revision).

B. The method of disinfection shall be in accordance with the methods outlined in the Attachment provided hereto these documents a copy of AWWA Standard for Disinfecting Water Mains C651 except that disinfection in accordance with Section 4.3, TABLET METHOD, is not acceptable.

C. The basic disinfection procedure consists of:

1. Removing, by flushing or any approved method necessary, any materials that may have entered the watermain.
2. Chlorinating any residual contamination that may remain, and flushing the chlorinated water

from the main.

3. Protecting the existing distribution system from backflow due to hydrostatic pressure test and disinfection procedures.
4. Determining the bacteriological quality by laboratory test after disinfection.
5. Redisinfection, if necessary.
6. Final connection of the approved new watermain to the active distribution system.

D. When the project includes existing mains which are wholly or partially dewatered, special disinfection procedures in accordance with Subsection 3.9 (hereunder) and the provisions of Section 4 of AWWA C651 shall be utilized.

3.8 TESTING:

A. Sequence of Testing:

1. The hydrostatic test and leakage test shall be performed prior to disinfection to preclude the possibility of having to redisinfect if any repairs are necessary.

B. Hydrostatic Test:

1. After the water mains have been installed and before pipe joints, fittings, valves or other appurtenances are covered, all of the excess air shall be expelled and the water main shall be pressure tested.
2. Test pressure shall be at least 1.5 times the maximum working pressure at the point of lowest elevation in the section of pipe tested and at least 1.25 times the maximum working pressure at the point of highest elevation in the section of pipe tested, whichever is greater.
3. For pipe size of up to and including 16-inch, test pressure shall not exceed 350psi. For pipe size of 18-inch and greater, test pressure shall not exceed 250psi.
4. The pressure test shall be at least two hours in length, preferably before complete backfilling of the pipeline, when the joints are exposed.
5. All visible leaks, any cracked or defective pipe, fittings, valves, or hydrants discovered in consequent of the pressure test shall be removed and replaced by the Contractor with sound material; and the test shall be repeated until results satisfactory to the Engineer are obtained.
6. The Contractor shall furnish all necessary appliances and make the test at his own expense.

C. Leakage Test:

1. Leakage test shall be conducted concurrently with the pressure test.
2. Leakage is defined as the quantity of water to be supplied into the newly laid pipe or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.
3. The leakage test shall be performed in accordance with AWWA Standard C600 "year of the latest revision" as well as the Standard Design and Construction Requirements for Water Distribution Main Extensions for the Town of Newburgh Consolidated Water District.
4. There shall be no leakage during the test. The test pressure during the leakage test and the duration shall be the same as the hydrostatic test and shall be maintained within 5 psi.
5. The Contractor shall furnish all necessary appliances and make the test at his own expense.

D. Bacteriological Testing:

1. After the piped system has been disinfected and thoroughly flushed, but before the new water lines are final connected to the distribution system or placed in service, the water shall be tested for bacteriological quality and shall show the absence of coliform organisms.
2. Two (2) consecutive sets of acceptable samples, taken at least 24 hours apart shall be collected from the new main. At least one set of samples shall be collected from every 1200 ft. of new watermain, plus one set from the end of the line and at least one set from each branch.
3. Samples shall be collected in sterile containers treated with sodium thiosulfate in accordance with the procedures of the "Standard Methods for the Examination of Water and Wastewater". Samples shall be collected by qualified personnel from sampling taps installed on the main. No hose or fire hydrant shall be used in the collection of samples.
4. Samples shall be tested by a laboratory approved by the New York State Department of Health for bacteriological testing acceptable to the Engineer. Original signed copies of the results of these tests shall be submitted in writing to the Engineer.
5. All samples shall be tested for bacteriological quality in accordance with "Standard Methods for the Examination of Water and Wastewater", and shall show the absence of coliform organisms. A standard heterotrophic plate count may be required at the option of the Owner and/or Engineer.
6. Sufficient samples shall be collected and tested from the various portions of the system to indicate, to the satisfaction of the Engineer, that a uniform representative sample has been obtained and tested.
7. If samples tested fail to produce satisfactory results, the main shall be reflushed and resampled, and, if necessary, redisinfected as called for in Section 5.1.6 of C651 (latest revision).
8. If trench water has entered the new main during construction or, if in the opinion of the Owner and/or Engineer, excessive quantities of dirt or debris have entered the new main, bacteriological samples shall be taken at intervals of approximately 200 ft and shall be identified by location. Samples shall be taken of water that has stood in the new main for at least 16 hours after final flushing has been completed.
9. The Contractor shall furnish all necessary appliances and make the test at his own expense.

3.9 SPECIAL DISINFECTION PROCEDURES (FOR CUT-INS OR REPAIRS TO EXISTING MAINS):

A. The procedures referenced herein primarily apply to those cases when existing mains are wholly or partially dewatered or, where in the opinion of the Engineer, conditions warrant utilization of these special procedures.

B. When an existing main is opened, either by accident or by design, the excavation will likely be wet and may be badly contaminated from nearby sewers. Liberal quantities of hypochlorite applied to open trench areas will lessen the danger from such pollution. Provisions shall be made to provide such chlorination in these cases.

C. The interior of all pipe and fittings (particularly couplings and sleeves) used in making the repair or installation shall be swabbed or sprayed with a 1 percent hypochlorite solution before they are installed.

D. The Contractor shall utilize thorough flushing as an effective and practical means of removing

contamination introduced during repairs. If valve and hydrant locations permit, flushing toward the work location from both directions is recommended. Flushing shall be started as soon as the repairs are completed and shall be continued until discolored water is eliminated. At least 24-hour prior notice shall be made to the Owner and Engineer before any flushing is performed.

E. After the appropriate procedures have been completed, the existing main may be returned to service prior to completion of bacteriological testing in order to minimize the time customers are out of water.

F. Bacteriological samples shall be taken after repairs are completed to provide a record for determining the procedure's effectiveness. If the direction of flow is unknown, then samples shall be taken on each side of the main break (or cut-in installation). If positive bacteriological samples are recorded, then the situation shall be evaluated with the Engineer and Owner, at which time corrective actions shall be determined and then taken by the Contractor. Daily sampling shall be continued by the Contractor until two consecutive negative samples are recorded.

PART 4 - MEASUREMENT AND PAYMENT:

4.1 Measurement shall be made on the basis of lineal foot of ductile iron water pipe of the type and size(s) properly placed, as measured by the Engineer. Measurements shall be made horizontally along the axis of the pipe and shall include all fittings and/or accessories not specifically included for measurement and payment under other items in the Proposal.

4.2 Payment will be made at the unit price under the appropriate items(s) of the Proposal; the price bid shall include excavation, crushed stone foundation, backfill in a manner acceptable to the Engineer, including all labor, materials, fittings, equipment, rodding and thrust blocks, all "specials" and appurtenances, disinfection, testing and other work, miscellaneous work as called for or shown, as required to complete the work.

END OF SECTION 331113.13

SECTION 331113.23 - POLYVINYL CHLORIDE (PVC) PIPE FOR WATER SERVICE

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. This specification section includes all materials, equipment, labor, and incidentals required for the supply and installation of polyvinyl chloride (PVC) or molecularly-oriented polyvinyl chloride (PVCO) pipe and fittings, 4-inch diameter to 60-in diameter for use in potable and non-potable water systems.

1.2 RELATED SECTIONS:

A. Submittals Procedures – Section 013300

B. Trenching, Backfilling and Compaction Work – Section 312333

C. Tracer Wire - Section 330598

D. Pressure and Leakage Testing of Pipelines – Section 330110.13

E. Disinfection Testing of Pipelines – Section 331301

1.3 REFERENCES:

A. The Contractor and/or Pipe Manufacturer shall follow the standards listed below, except as otherwise specified herein. The latest revision or edition in effect at the time of bid opening shall be utilized.

1. American Society for Testing and Materials (ASTM)
    a. D1784 – Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
    b. D2241 – Polyvinyl Chloride (PVC) Pressure-Rated Pipe (SDR PR Series)
    c. D2774 – Practice for Underground Installation of Thermoplastic Pressure Piping
    d. D3139 – Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
    e. F477 – Elastomeric Seals (Gaskets) for Joining Plastic Pipe
2. American Water Works Association (AWWA)
    a. C605 – Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
    b. C651 – Disinfecting Water Mains
    c. C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. through 60 in. (100 mm through 1500 mm), for Water Transmission and Distribution
    d. C907 – Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 in. through 12 in. (100 mm through 300 mm), for Water, Wastewater, and Reclaimed Water Service

e. C909 – Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 in. through 24 in. (100 mm through 600 mm) for Water, Wastewater, and Reclaimed Water Service
f. M23 – PVC Pipe – Design and Installation

3. National Science Foundation (NSF)
   a. 61 – Drinking Water System Components – Health Effects
   b. Uni-Bell PVC Pipe Association
4. UNI-PUB-8 – Tapping Guide for PVC Pressure Pipe
5. UNI-PUB-9 – Installation of PVC Pressure Pipe
6. Handbook of PVC Pipe Design and Construction

1.4 QUALIFICATIONS:

A. The pipe and fittings shall be designed, manufactured, and installed in accordance with industry standards and shall comply with the specification requirements herein.

1.5 SUBMITTALS:

A. Conform to the requirements of Section 013300 – Submittal Procedures.

B. Submit product data on pipe, fittings, gaskets and appurtenances as required to ensure products meet the requirements of this specification.

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Pipe shall be shipped so as to not bend, dent, or otherwise damage the pipe during transport.

B. Contractor shall take all necessary precautions to prevent damage to pipe and fittings during delivery and unloading.

C. Owner shall observe and inspect unloading of pipe to ensure proper unloading procedures are followed.

D. Under no circumstances will pipe be allowed to be rolled, pushed, or dropped off from any height for delivery, storage, or installation. Any pipe found to have been damaged due to improper handling procedures truck will be immediately marked for identification and removed from the jobsite at the Contractor's expense.

E. Stacking of pipe shall be performed in accordance with Pipe Manufacturer's recommendations.

F. Once pipe has been unloaded, it shall be stored as near to its point of installation as possible. Contractor shall limit moving or restacking of pipe prior to installation. Contractor shall keep track of any moving or restacking of pipe materials during installation and make such records available to Owner and Pipe Manufacturer if needed.

G. Where necessary, because of ground conditions, store pipe on wooden sleepers, spaced suitably and of such widths as not to allow deformation of pipe at point of contact with sleeper or between supports.

H. Pipe shall not be stored close to heat sources or hot objects such as heaters, boilers, steam lines, and engine exhaust.

I. If pipe is to be exposed to direct sunlight for extended periods (in excess of two years from the date of manufacture), then Contractor shall cover/shade pipe utilizing canvas or other opaque materials. Black plastic will not be acceptable as a shading material.

J. Gaskets shall be protected from exposure to excessive heat, prolonged direct sunlight, and oil and grease. Contractor shall not store gaskets near electrical motors or transformers or other sources of ozone.

K. Material storage shall be performed in accordance with Pipe Manufacturer's recommendations.

PART 2 - MATERIALS

2.1 PIPE:

A. PVC pipe shall be manufactured and supplied in accordance with AWWA C900. PVCO pipe shall be manufactured and supplied in accordance with AWWA C909.

B. PVC pipe for potable water use shall meet the requirements of NSF 61.

C. Pipe shall have lay lengths between 14 and 22 feet unless otherwise specified by the Owner.

D. The pipe shall be made of PVC compound having a cell classification of 12454 in accordance with ASTM D1784.

E. Pipe shall be homogenous throughout, free of voids, cracks, inclusions, and other defects.

F. Pipe shall have markings at intervals of 5ft or less including:
1. Nominal pipe size and
2. OD base (e.g. CIOD or IPS)
3. PVC
4. Dimension ratio
5. Pressure class in psi
6. Hydrostatic integrity test pressure
7. AWWA designation
8. Pipe Manufacturer's name or trademark
9. Production run record or lot code
10. Mark of certifying agency (for potable water service) or "NOT FOR POTABLE USE" (for non-potable water service)
11. Maximum allowable axial joint deflection in degrees

G. Pipe for potable water use shall be blue, yellow, or white in color. Pipe for recycled or reclaimed water use shall be purple in color. Pipe for other non-potable water uses shall be green or white in color.

H. Pipe outside diameters shall be equal to those of cast iron unless otherwise specified by the Owner.

2.2 PIPE DESIGN:

A. Pipe shall be supplied to meet the pressure requirements of the project as follows:
   1. Working Pressure (Pw) of 150 psi
   2. Occasional Surge Pressure (Pt) of 755 psi
   3. Field Hydrostatic Test Pressure (Pft) of 150 psi
      a. The hydrostatic test should typically be 1.25 times the stated anticipated maximum sustained working pressure of the pipeline (measured at the highest elevation of the test section) or 1.5 times the stated sustained working pressure (measured at the lowest elevation of the test section), whichever is greater. In no case should the test pressure exceed the rated working pressure for any joint, thrust restraint, valve, fitting, or other connected appurtenance of the test section.

B. Pipe shall be supplied to meet the external loading requirements of the project as follows:

   1. Designed for a Type V trench in accordance with AWWA C605
   2. Maximum calculated deflection of 7.5%
   3. Live loads as calculated per AWWA M23 based on the profile shown on the plans
   4. Depth of cover as shown on the plans
   5. Trench width as shown on the plans

2.3 FITTINGS:

A. PVC fittings shall be supplied in accordance with AWWA C900 and/or C907. PVCO fittings shall be supplied in accordance with AWWA C909 and/or C907.

B. Fittings may also be supplied as ductile iron fittings in accordance with AWWA C110 and/or C153.

2.4 PIPE JOINTS:

A. Joints shall be gasket, bell and spigot and push-on type conforming to ASTM D3139.

B. Gasket materials shall meet requirements of ASTM F477.

C. Joint lubricant shall be approved by the Pipe Manufacturer, water soluble, non-toxic, and NSF approved for potable water applications.

D. Restraining of joints against thrust shall be accomplished by either integral joint restraint systems provided by the Pipe Manufacturer, external restraint systems, or thrust blocking.

E. Size and type of restraint will depend on pressures, pipe size, type of fitting/appurtenance, profile, soil type, and depth of cover. Contractor shall ensure that all external joint restraint systems are installed correctly including appropriate torqueing of bolts.

F. Thrust forces will be calculated as per AWWA M23 manual.

PART 3 – EXECUTION

3.1 GENERAL:

A. Install pipe, fittings, specials, and appurtenances in accordance with AWWA C605, M23, UNI-B-9 and in accordance with the Pipe Manufacturer's recommendations.

B. Lay pipe to the lines and grades as indicated on the Plans.

C. Tapping of pipe shall be in accordance with AWWA C605, M23, UNI-B-8 and Pipe Manufacturer's recommendations. Direct tapping shall not be permitted. Tapping will require the use of a tapping saddle.

D. Provide tracer wire and identification tape in accordance with specifications herein.

3.2 PIPE HANDLING:

A. Handle pipe and piping materials with care to avoid damage.

B. Prior to installation, each pipe length shall be carefully inspected for damage.

C. All pipe, fittings, and appurtenances shall be thoroughly cleaned before installation and shall be kept clean until installation and backfilling has completed.

D. Use only nylon ropes, slings, or other lifting devices that will not damage the surface of the pipe.

E. Keep the pipe clean and free of debris, dirt, animals, and trash during and after laying operations.

F. At the close of each operating day, seal the open end of the pipe using a gasketed night cap.

3.3 PIPE INSTALLATION:

A. Do not drag pipe over gravel or rock. Avoid striking rocks or hard objects when lowering pipe into the trench.

B. Placement of pipe and fittings into the trench should be done with ropes and skids, slings on a backhoe bucket, or by hand.

C. Pipe or fittings shall not be thrown into the trench and no part of the pipe shall be allowed to take an unrestrained fall onto the trench bottom.

D. Joint sockets shall be carefully cleaned before pipes are lowered into trenches.

3.4 JOINT MAKING:

A. Install push-on joints as defined in AWWA C900.

B. Inspect the gasket, pipe spigot bevel, gasket groove, and sealing surfaces for damage or deformation. In cases when gaskets are supplied separately from pipe, Contractor is to ensure that gaskets supplied are designed for the pipe in use.

C. Clean the gasket of all extraneous matter.

D. Apply a thin film of joint lubricant to the inside of the gasket and the outside of the spigot prior to entering the spigot into the bell. Lubricated spigots ends shall not come in contact with soil or backfill material.

E. Insert the spigot end of the pipe carefully into the bell until the reference mark on the spigot is flush with the bell. If two reference marks are present, the mark closest to the spigot end shall be considered the minimum insertion mark, and the second mark shall be considered the maximum insertion mark. Under no circumstances will the spigot be inserted into the bell past the reference mark or maximum insertion mark.

F. For small diameter pipe, use the bar and block method for joint assembly or other method approved for use by the Owner and Pipe Manufacturer.

G. For large diameter pipe, use mechanical assistance such as hydraulic pipe pullers, jacks, pulleys, come-alongs, or a backhoe bucket. Observation by a spotter will be required when assembling joints for large diameter pipe to prevent over-insertion.

H. When using a field cut plain end piece of pipe, bevel the end with a beveling tool, wood rasp, or power sander to the same angle and length as provided on the factory-finished pipe. Redraw the insertion line on the spigot using a factory-marked spigot as a guide.

I. Angular changes in pipe alignment shall be achieved by either fittings, joint deflection, or longitudinal bending of the pipe.

J. Joint deflection shall not exceed the Pipe Manufacturer’s recommendation.

K. Field assembly of pipe fittings shall follow the Pipe Fittings Manufacturer’s recommendations.

L. Mechanical joints shall be assembled per the Pipe and/or Fittings Manufacturer’s recommendations as well as the recommendations of the mechanical joint supplier.

3.5 LONGITUDINAL PIPE BENDING:

A. Controlled changes in direction may be accomplished by longitudinal bending of the pipe barrel.

B. Pipe Manufacturer will be consulted prior to start of construction for recommendations on longitudinal bending.

C. When longitudinal bending of pipe is utilized, Contractor shall use manual force alone to achieve prescribed bending. Mechanical means shall not be utilized to achieve longitudinal bending of the pipe.

D. When the desired change of direction in the pipeline exceeds the maximum allowable deflection specified, the longitudinal bending shall be made throughout a number of pipe lengths.

E. Contractor will ensure that pipe joints will not be over-pulled or over-inserted during longitudinal bending operations.

3.6 CLEANING, DISINFECTION, AND TESTING:

A. All finished installations shall be pressure tested and disinfected in accordance with AWWA C605, AWWA C651 and the specifications herein.

B. Pipe shall be backfilled and braced to prevent movement during pressure testing. Testing of exposed or unburied pipe will not be permitted without the explicit approval of the Owner and Pipe Manufacturer.

C. Joint restraint at fittings should be permanent and constructed to withstand test pressure. If concrete thrust blocks are used, sufficient time must be allowed before testing to permit the concrete to cure.

D. Test ends should be restrained to withstand thrusts developed while under pressure.

E. The pipe shall be filled slowly from the lowest point on the line. Flow velocity during line filling should not exceed 1 ft/s.

F. All air should be expelled from a pipeline during filling and again before acceptance tests are conducted.

G. All fixtures, devices, or other accessories which are to be connected to the lines and which would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines are plugged or capped as required during the testing procedures.

H. Make-up water allowances shall not exceed the limits of AWWA C605. Any leaks that may occur shall be repaired in accordance with the recommendations of the Pipe Manufacturer to the satisfaction of the Owner, and the system shall be retested until no leaks are found.

I. Once the pipe has been successfully pressure tested, it shall be flushed and disinfected. Flushing should be done at flow rates sufficient to provide a velocity in the pipe of at least 3.0 ft/s. Disinfection of lines shall comply with AWWA C651 and the specifications referenced herein, except that disinfection in accordance with AWWA C651 Section 4.3 Tablet Method is <u>not</u> acceptable.

PART 4 - MEASUREMENT AND PAYMENT:

4.1 MEASUREMENT:

A. Measurement shall be made on the basis of lineal foot of PVC water pipe of the type and size(s) properly placed, as measured by the Engineer. Measurements shall be made horizontally along the axis of the pipe and shall include all fittings and/or accessories not specifically included for measurement and payment under other items in the Proposal.

4.2 PAYMENT:

A. Payment will be made at the unit price bid under the appropriate item(s) of the Proposal; the price bid shall include ,excavation, shoring, dewatering, disposal, bedding, NYSDOT sub-base backfill, compaction, compaction testing, thrust blocks, retaining rods, fittings and specials, including reducers, disinfection, testing and sampling, restoration; identification tape, locating wire, record drawings, miscellaneous work, including connection to existing mains and appurtenances, abandonment of existing mains, as required to complete the work.

END OF SECTION 331113.23

SECTION 331216.01 - RESILIENT-DISC GATE VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Furnish and install resilient-disc gate valves and valve boxes (if applicable) at locations shown on the plans and in accordance with these specifications.

1.2 RELATED WORK:

A. Polyvinyl Chloride (PVC) Water Pipe and Specials - Section 331113.23

1.3 EXISTING CONDITIONS:

A. It shall be the Contractor's responsibility to investigate all site conditions that may affect his work.

1.4 SUBMITTALS REQUIRED:

A. The Contractor shall not place any materials until such time that each material used in the work has been accepted by the Engineer.

B. Submittals shall comply with the requirements as delineated in the Contract General Conditions.

PART 2 - MATERIALS

2.1 VALVE (GENERAL):

A. Shall be "Ken-Seal" as manufactured by ITT Kennedy Valve, or acceptable equal.

B. Shall conform to AWWA C509 "year of latest revision".

C. Shall turn to open in the direction similar to the existing municipal valves and have a rustproof steel, hex-shaped operating nut.

D. The ends shall be flanged or mechanical joint with adapters at the Contractor's option, unless a specific valve body is indicated on the plans.

E. Valves shall be non-rising stem, unless otherwise noted.

2.2 VALVE BOXES:

A. Shall be provided for all exterior installations, unless otherwise noted.

B. Shall be manufactured by Kennedy Valve, the Mueller Company, or acceptable equal.

C. Shall be five and one-quarter inch (5 1/4") inside diameter.

D. Shall be a two piece, cast iron, standard slide type, with cast iron cover of proper length for actual trench depth.

E. Each coverface shall be lettered "WATER" (or other designation as specifically applicable) and have an arrow indicating direction of opening.

PART 3 - CONSTRUCTION DETAILS

3.1 PLACEMENT (GENERAL):

A. Valves shall be installed in accordance with the manufacturer's instructions for the type of ends used at the location shown on the plans.

B. At the intersections of mains, valves shall be as close to the intersection as possible.

C. Valve boxes (if provided) shall be centered and plumb over the operating nut, and the cover shall be set at finished grade of pavement or in areas outside pavement, at height acceptable to the Engineer.

D. Valve boxes shall be clear of dirt, stones or any other debris prior to acceptance.

E. Valve boxes shall not bear on the valve and shall be independently supported.

F. Valves shall be operated to determine that they are in correct operating condition and do not leak, prior to the completion of backfilling, after hydrostatic and leakage tests are completed.

G. Valve boxes shall be supported so they do not transmit shock or stress to the valve.

PART 4 - MEASUREMENT AND PAYMENT

4.1 Unit of measurement shall be for each complete valve and valve box assembly properly installed.

4.2 Payment will be made based on the price bid per unit in the Proposal. Payment will be made for the completed assembly.

4.3 The price bid per unit shall include the cost for the valve, valve box and appurtenances as required for the complete installation including all labor, equipment and materials as required to complete the work.

END OF SECTION 331216.01

SECTION 331216.02 - BUTTERFLY VALVES, AIR SERVICE

PART 1 – GENERAL

1.1 WORK INCLUDED:

Furnish and install butterfly valves with operators at the locations shown on the plans and in accordance with these specifications.

1.2 EXISTING CONDITIONS:

It shall be the Contractor's responsibility to investigate all site conditions that may affect the work.

1.3 STANDARDS:

A. The applicable codes and standards from the referenced association shall form a part of this section, and all equipment furnished shall comply with the applicable requirements, including, but not necessarily limited to, the following:

1. American Society of Testing and Materials (ASTM):

a. ASTM A126-84 Gray Iron Castings for Valves, flanges and pipe fittings.
b. ASTM A536-84 Ductile Iron Castings.

2. American National Standards Institute (ANSI)

a. ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings.

3. American Water Works Association (AWWA)

a. C504-87 Rubber Seated Butterfly Valves
b. C540-87 Power Actuating Devices for Valves and Sluice Gates

4. National Electrical Manufacturers Association (NEMA)

1.4 SUBMITTALS REQUIRED:

A. The Contractor shall not deliver nor place any materials, until such time that shop drawings for each material used in the work has been submitted and accepted by the Engineer.

B. Shop Drawings shall indicate the size, construction, assembly, materials of manufacture, dimensions, and all other pertinent information to indicate compliance with this Specification and as required, such that the system can be determined acceptable by the Engineer.

C. Six (6) complete sets of Shop Drawings shall be submitted to the Engineer. The Shop Drawings

shall bear the Contractor's stamp of approval indicating that he has reviewed the contents, and that same complies with the Contract requirements.

D. Shop Drawing submittals shall conform to the requirements of Section 7.16 of the General Conditions.

PART 2 - MATERIALS

2.1 GENERAL:

A. Valves, actuators, and positioners shall be provided by DeZurik, Clow, Kennedy, or acceptable equal.

B. Valves provided shall be specifically designed for air service of the type and character required at the F.C.I. Otisville Facility.

C. Valves shall be designed to operate at a 50 psi maximum pressure and a temperature range of -40 to 160 degrees Fahrenheit.

D. Valves shall provide drip-tight shutoff at differentials up to 50 psi.

2.2 CONSTRUCTION:

A. Body:

1. Valve body shall be cast iron ASTM A-126, Class B.
2. Valves shall be either wafer or lug design.
3. Drilling shall conform to ANSI B16.1, Class 125 or 150.
4. Bodies of all flangeless wafer valves shall have 4 flange bolt guides to center the body in the pipeline.

B. Disc:

1. Disc shall utilize air-profile design.
2. Disc shall be constructed of cast iron ASTM A-48 or ductile iron ASTM A-536, with disc edge of monel, stainless steel or nickel coated.

C. Shaft:

1. Shaft shall be of one piece and constructed of hi-strength carbon steel or stainless steel.
2. Shaft seals shall be provided to prevent leakage and to prevent bearings from internal and external corrosion.

D. Seat:

1. Elastomer seats shall be fastened to the body.
2. Seats shall be of EPDM or BUNA and shall be field replaceable without special tools.
3. Elastomer thickness shall be a minimum of one-half (1/2) inch, not inclusive of backing,

rings, or stiffeners.

E. Bearings:

1. All shaft bearings shall be of the self-lubricating, corrosion resistant, sleeve type.

F. Packing:

1. All valves shall have adjustable or self-adjusting packing materials.
2. Packing shall be suitable for the temperature and service conditions.

G. Actuators:

1. All actuators shall be sized for air service applications.
2. Torque conditions after three (3) years service should be used in sizing of actuators.

H. Painting:

1. Exterior iron or steel surfaces of each valve shall be shop painted per AWWA C-504.

2.3 MANUALLY OPERATED VALVES:

1. All manual butterfly valves shall be furnished with lever or rotary actuators.
2. All overhead valves (greater than five feet above finished floor elevation) shall be supplied with chainwheel actuators.

2.4 MOTOR OPERATED VALVES (QUARTER-TURN VALVES):

A. The electric motor operator shall consist of motor, reduction gearing, position limit switches and torque limiting switches mounted in a NEMA IV housing. Actuators shall be rated for 50 PSI working pressure.

B. The motor shall be of the high torque type, designed for continuous duty rating. Motors and wiring shall have Class "B" or better insulation. Overload protection shall be provided by auto-reset thermal trip circuit breakers embedded in the motor windings. All motor leads shall be terminated at an internal terminal strip. The motor will operate on an AC power supply of 120 volts, single phase, 60 cycle.

C. The integral self-locking power gearing shall be compound epicyclic or combined helical and worm gear type only. Motor breakers are unacceptable. Gearing shall be grease or oil lubricated with high speed parts running on anti-friction bearings. Motor shall be UL listed and labeled. Motor shall operate from open to full close in 60 seconds. Disassembly of gears shall not be required to remove the motor.

D. The handwheel shall not rotate during electrical operation. When the unit is being operated manually, it shall automatically return to electric operation when the handwheel is released. The transfer from electrical operation to manual operation shall be accomplished by a declutching mechanism, which will disengage the motor mechanically. The unit shall be capable of being clutched or declutched while the motor is energized with no damage to the clutch or gear

mechanism. Clockwise rotation of the handwheel shall close the valve. If the motor is energized during manual operation, the unit shall remain in manual mode without endangering personnel operating the unit.

E. Failure of the motor or motor gearing shall not hinder manual operation. Two sets of limit switches set at the open and close positions shall be provided and are to be geared directly to the valve to follow its position at all times, including during manual operation. Additional switches shall be provided, if required.

F. A double-acting torque limiting switch shall be provided, which is responsive to the mechanical torque developed by seating or an obstruction.

PART 3 - CONSTRUCTION DETAILS

3.1 PLACEMENT (GENERAL):

A. Valves shall be installed in accordance with the manufacturer's instructions for the type of ends used at the location shown on the plans.

3.2 GUARANTEES:

A. Written guarantees shall be provided by the Contractor for all labor and materials, for a period of one year from the date of final completion and acceptance of the work, by the Owner.

B. The guarantees shall include an agreement to repair and make good, at the Contractor's expense, any or all defects which may appear in the work or materials.

3.3 TESTING:

A. Prior to the final acceptance of the work, and prior to any instruction time, the Contractor shall schedule a joint inspection with the engineer and Owner, to demonstrate the following:

1. The equipment is complete and installed in accordance with the manufacturer's recommendations and Specifications, and is operating satisfactorily.
2. Tests performed on the equipment indicate satisfactory operation and that the equipment has been properly set, aligned and adjusted.

3.4 OPERATION AND MAINTENANCE MANUALS:

A. After all start-up and testing work has been completed, and the equipment is operating satisfactorily, the manufacturer of the equipment shall prepare and submit six (6) complete, original operation and maintenance (O & M) manuals for each type of valve, actuator, etc., supplied.

B. Manuals shall reflect all operation, maintenance and inspection functions, applicable to the specific equipment furnished.

C. Manuals shall include information regarding any accessories and appurtenances furnished specific to the project, as well as any modifications or adjustments made during erection and start-up.

D. Manuals shall include complete parts lists, names and telephone numbers for the manufacturer and local representatives for all equipment, and any other pertinent data regarding replacement parts.

E. Manuals shall be furnished in bound form, in quality 3-ring binders (or other forms found acceptable by the Owner) with identification on the face and binder as to the equipment for which it applies.

PART 4 - PAYMENT

4.1 All work required for the complete installation, including all labor, plant, materials, equipment and specialties; as necessary to complete the work herein noted, otherwise called for, shown and/or required, shall be the responsibility of the Contractor, and payment shall be deemed included under the lump sum bid in the Proposal of the Contract.

END OF SECTION 331216.02

SECTION 331216.03 BUTTERFLY VALVES, WATER/SEWAGE SERVICE

PART 1 – GENERAL

1.1 WORK INCLUDED:

A. Furnish and install butterfly valves with operators at the locations shown on the plans and in accordance with these specifications.

1.2 EXISTING CONDITIONS:

A. It shall be the Contractor's responsibility to investigate all site conditions that may affect the work.

1.3 STANDARDS:

A. The applicable codes and standards from the referenced association shall form a part of this section, and all equipment furnished shall comply with the applicable requirements, including, but not necessarily limited to, the following:

1. American Society of Testing and Materials (ASTM):

a. ASTM A126-84 Gray Iron Castings for Valves, flanges and pipe fittings.
b. ASTM A536-84 Ductile Iron Castings.

2. American National Standards Institute (ANSI)
3. ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings.
4. American Water Works Association (AWWA)

a. C504-87 Rubber Seated Butterfly Valves
b. C540-87 Power Actuating Devices for Valves and Sluice Gates

5. National Electrical Manufacturers Association (NEMA)

1.4 SUBMITTALS REQUIRED:

A. The Contractor shall not deliver nor place any materials, until such time that shop drawings for each material used in the work has been submitted and accepted by the Engineer.

B. Shop Drawings shall indicate the size, construction, assembly, materials of manufacture, dimensions, and all other pertinent information to indicate compliance with this Specification and as required, such that the system can be determined acceptable by the Engineer.

C. Six (6) complete sets of Shop Drawings shall be submitted to the Engineer. The Shop Drawings shall bear the Contractor's stamp of approval indicating that he has reviewed the contents, and that same complies with the Contract requirements.

D. Shop Drawing submittals shall conform to the requirements of Section 7.16 of the General Conditions.

PART 2 - MATERIALS

2.1 GENERAL:

A. Valves, actuators, and positioners shall be provided by DeZurik, Clow, Kennedy, or acceptable equal.

B. Valves provided shall be specifically designed for waste water service of the type and character required at the F.C.I. Otisville Facility.

C. All valves shall meet the requirements of AWWA C-504-87.

D. Valves shall be designed to operate at a 200-psi maximum pressure and a temperature range of -40 to 160 degrees Fahrenheit.

E. Valves shall provide drip-tight shutoff at differentials of up to 200 psi.

2.2 CONSTRUCTION:

A. Body:

1. Valve body shall be cast iron ASTM A-126, Class B.
2. Valves shall be either wafer, flanged or lug design.
3. Drilling shall conform to ANSI B16.1, Class 125 or 150.

B. Disc:

1. Disc shall be offset to provide an uninterrupted 360-degree seating edge.
2. Disc shall be constructed of cast iron ASTM A48 or ductile iron ASTM A-536, with disc edge of monel, stainless steel or nickel coated.

C. Shaft:

1. Shaft shall be constructed of hi-strength carbon steel or stainless steel.

D. Seat:

1. The seats shall be fastened in the valve body.
2. Seats shall be of EPDM, BUNA, Acrylonitrile Butadiena and shall be field replaceable without special tools.

E. Bearings:

1. All shaft bearings shall be of the self-lubricating, corrosion resistant, sleeve type.

F. Packing:

1. All valves shall have adjustable or self-adjusting packing materials.
2. Packing shall be suitable for the temperature and service conditions.

G. Actuators:

1. All actuators shall be properly sized for the intended applications.
2. Torque conditions after three (3) years service should be used in sizing of actuators.

H. Painting:

1. Exterior cast iron or steel surfaces of each valve shall be shop painted per AWWA C504.

I. Manually operated valves.

1. All manual butterfly valves shall be furnished with lever or rotary actuators.
2. All overhead valves (greater than five feet above finished floor elevation) shall be supplied with chainwheel actuators.

J. Motor operated valves (quarter-turn valves).

1. The electric motor operator shall consist of motor, reduction gearing, position limit switches and torque limiting switches mounted in a NEMA IV housing. Actuators shall be rated for 50 PSI working pressure
2. The motor shall be of the high torque type, designed for continuous duty rating. Motors and wiring shall have Class "B" or better insulation. Overload protection shall be provided by auto-reset thermal trip circuit breakers embedded in the motor windings. All motor leads shall be terminated at an internal terminal strip. The motor will operate on an AC power supply of 120 volts, single phase, 60 cycle.
3. The integral self-locking power gearing shall be compound epicyclic or combined helical and worm gear type only. Motor breakers are unacceptable. Gearing shall be grease or oil lubricated with high speed parts running on anti-friction bearings. Motor shall be UL listed and labeled. Motor shall operate from open to full close in 60 seconds. Disassembly of gears shall not be required to remove the motor.
4. The handwheel shall not rotate during electrical operation. When the unit is being operated manually, it shall automatically return to electric operation when the handwheel is released. The transfer from electrical operation to manual operation shall be accomplished by a declutching mechanism, which will disengage the motor mechanically. The unit shall be capable of being clutched or declutched while the motor is energized with no damage to the clutch or gear mechanism. Clockwise rotation of the handwheel shall close the valve. If the motor is energized during manual operation, the unit shall remain in manual mode without endangering personnel operating the unit.
5. Failure of the motor or motor gearing shall not hinder manual operation. Two sets of limit switches set at the open and close positions shall be provided and are to be geared directly to the valve to follow its position at all times, including during manual operation. Additional switches shall be provided, if required.

A double-acting torque limiting switch shall be provided, which is responsive to the mechanical torque developed by seating or an obstruction.

PART 3 - CONSTRUCTION DETAILS.

3.1 PLACEMENT (GENERAL):

A. Valves shall be installed in accordance with the manufacturer's instructions for the type of ends used at the location shown on the plans.

3.2 GUARANTEES:

A. Written guarantees shall be provided by the Contractor for all labor and materials, for a period of one year from the date of final completion and acceptance of the work, by the Owner.

B. The guarantees shall include an agreement to repair and make good, at the Contractor's expense, any or all defects which may appear in the work or materials.

3.3 TESTING:

A. Prior to the final acceptance of the work, and prior to any instruction time, the Contractor shall schedule a joint inspection with the engineer and Owner, to demonstrate the following:

1. The equipment is complete and installed in accordance with the manufacturer's recommendations and Specifications, and is operating satisfactorily.
2. Tests performed on the equipment indicate satisfactory operation and that the equipment has been properly set, aligned and adjusted.

3.4 OPERATION AND MAINTENANCE MANUALS:

A. After all start-up and testing work has been completed, and the equipment is operating satisfactorily, the manufacturer of the equipment shall prepare and submit six (6) complete, original operation and maintenance (O & M) manuals for each type of valve, actuator, etc., supplied.

B. Manuals shall reflect all operation, maintenance and inspection functions, applicable to the specific equipment furnished.

C. Manuals shall include information regarding any accessories and appurtenances furnished specific to the project, as well as any modifications or adjustments made during erection and start-up.

D. Manuals shall include complete parts lists, names and telephone numbers for the manufacturer and local representatives for all equipment, and any other pertinent data regarding replacement parts.

E. Manuals shall be furnished in bound form, in quality 3-ring binders (or other forms found acceptable by the Owner) with identification on the face and binder as to the equipment for

which it applies.

PART 4 - PAYMENT

All work required for the complete installation, including all labor, plant, materials, equipment and specialties; as necessary to complete the work herein noted, otherwise called for, shown and/or required, shall be the responsibility of the Contractor, and payment shall be deemed included under the lump sum bid in the Proposal of the Contract.

END OF SECTION 331216.03

SECTION 331219 - HYDRANT AND VALVE ASSEMBLY

PART 1 - GENERAL

1.1 WORK REQUIRED:

A. Furnish and install hydrant assemblies at the locations and depths shown on the Plans and in accordance with these Specifications.

B. Provide necessary thrust blocks and/or tie-rods as required or as shown on the Plans.

1.2 EXISTING CONDITIONS:

A. It shall be the Contractor's responsibility to investigate all site conditions that may affect his work.

1.3 SUBMITTALS REQUIRED:

A. The Contractor shall not place any materials until such time that each material used in the work has been accepted by the Engineer.

B. Submittals shall comply with the requirements as delineated in the Contract General Conditions.

PART 2.0 - MATERIALS

2.1 HYDRANTS:

A. All hydrants provided on any project shall at minimum meet the requirements of the municipality and/or match the current hydrants being installed wherein the work is being performed.

B. Unless otherwise directed by the Owner, the hydrants shall be provided with a main valve opening of 5-1/4", break flange construction, 6" inlet connection, having two(2) 2-1/2" hose nozzles and one(1) 4-1/2" pumper nozzle.

C. Hydrants (unless otherwise noted on the typical detail or directed by the Owner) shall be Centurion A-423 type as manufactured by Mueller Company, or acceptable equal.

D. Hydrants shall open in the same direction as existing hydrants within the municipality.

E. Shall conform to AWWA C502, latest revision.

2.2 AUXILIARY VALVES:

A. Shall be six inches (6") in size.

B. Provide with ends to match connecting pipe.

C. Shall conform to AWWA C500 (latest revision).

D. Unless otherwise directed by the Owner, shall be as manufactured by Clow or acceptable equal.

E. Shall be provided complete with 5-1/4" inside diameter, two-piece, cast iron, standard slide type valve box of proper length for actual trench depth.

F. Cover face for valve box shall be lettered "WATER" and have an arrow indicating direction of opening.

G. Valve boxes shall be manufactured by Clow or acceptable equal.

2.3 CONNECTING PIPING AND FITTINGS:

A. All connecting piping shall be Ductile Iron and all fittings shall be gray cast iron.

B. Both connecting piping and fittings shall be cement-lined, seal-coated, either push-on or mechanical joint, of the sizes and lengths shown on the Plans.

C. Thrust blocks shall be placed as shown on the Plans, and valves and hydrants shall be tied to the main by means of 3/4" galvanized tie rods, a minimum of two (2) per section, mounted 180° apart.

PART 3.0 - CONSTRUCTION DETAILS

3.1 GENERAL:

A. Contractor's attention is directed to the requirements for inspection, marking of rejected specimens, foundation and closing the pipe as found in the specifications for the water pipe being provided as found elsewhere in these documents. These requirements shall be met in the installation of Hydrant Assemblies.

B. Hydrants shall be installed to provide a minimum clear height to nozzle of eighteen (18) inches.

C. Hydrants shall be set and drained in accordance with the applicable detail shown on the Plan Sheet.

D. If groundwater, or evidence thereof, is noted within 2 ft. of the base of the hydrant, same shall immediately be brought to the attention of the Engineer. In such case, the Contractor shall plug the drain hole and the hydrant labeled to instruct the Fire Department to pump out the hydrant after use.

3.2 PAINTING:

A. Hydrants shall be furnished with a shopcoat of yellow paint.

B. Upon completion of the installation, the Contractor shall completely repaint the hydrant, using Koppers Glamortex 501 Enamel, or an acceptable equal. Color to match town Standard.

3.3 TESTING:

A. Testing shall be performed per the requirements as noted under the piping section of these Specifications.

B. All testing shall comply with the applicable standards of the American Water Works Association (AWWA).

3.4 DISINFECTION:

A. Disinfection of the water system will proceed only after completion of hydrant assembly installations.

B. Disinfection shall comply with the requirements as noted under the piping section of these specifications.

C. All disinfection shall comply with the applicable Standards of the American Water Works Association (AWWA).

PART 4.0 - MEASUREMENT AND PAYMENT

4.1 Unit of measurement shall be for each complete hydrant assembly properly installed.

4.2 Payment will be made based on the price bid per unit in the Proposal; payment will be made for the completed assembly.

4.3 The price bid per unit shall include the costs for the hydrant, valve, valve box, thrust blocks, tie rods, connecting piping, painting and all accessories and appurtenances as required for the complete installation including all labor, equipment and materials as required to complete the work.

4.4 Where no separate payment item is provided in the Contract proposal, no separate payment shall be made and valves shall be deemed included in other payment items of the proposal.

END OF SECTION 331219

SECTION 331301 – DISINFECTION TESTING OF PIPELINES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY:

A. The Contractor shall disinfect all potable and non-potable water pressure pipelines shown on the contract drawings in accordance with ANSI/AWWA C651, latest edition. The Tablet method described in ANSI/AWWA C651 shall not be acceptable. All piping and equipment shall be tested in the field in the presence of the Engineer.

B. Bacteriological samples shall be collected and analyzed on two consecutive days, 24 hours apart from one another. Samples shall be analyzed by an independent laboratory certified by the New York State Department of Health.

C. Chlorination shall not take place until:

1. The main is constructed in accordance with the Contract Documents as modified by the Engineer during construction and all construction permit requirements are met.
2. All blow offs, injection and sample points are constructed and ready for use.
3. The main has been pigged and thoroughly flushed with scouring velocities as needed.
4. The main has been successfully pressure and leakage tested as specified in Division 33.
5. Chlorine neutralization chemicals, and methods for application and disposal of chlorinated water, have been established by the Contractor. The Contractor shall dispose of the water without causing a nuisance, property damage, or contamination of waters of the State

1.3 RELATED SECTIONS:

A. Related Sections include the following:

1. Division 33 Sections for buried pipe installation requirements.
2. Division 33 Section “Pressure and Leakage Testing of Pipelines” for pressure testing requirements of pipelines.

1.4 SUBMITTALS:

A. Prior to Testing: A Disinfection Plan shall be prepared for review and acceptance prior to initiation of work.

1. Disinfection Plan:
   a. Type and form of disinfectant proposed.

b. Method and location of disinfectant injection.
c. Test locations.
d. Initial and final disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
e. Flushing locations.
f. Procedure for neutralizing disinfectant and for discharge of flushed water.
g. Proposed testing laboratory name, address and telephone number.

B. For closeout: Disinfection Test Reports performed as well as any laboratory results received as part of this work. Specifically:

1. Disinfection Report:
   a. Type and form of disinfectant used.
   b. Date and time of disinfectant injection start and time of completion.
   c. Test locations.
   d. Initial and final disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
   e. Date and time of flushing start and completion.
   f. Disinfectant residual after flushing in ppm for each outlet tested.
   g. Procedure for neutralizing disinfectant and for discharge of flushed water.
   h. Signature of person performing tests and signature of witness.

2. Bacteriological report:
   a. Date issued, project name, and testing laboratory name, address, and telephone number.
   b. Time and date of water sample collection.
   c. Name of person collecting samples.
   d. Test locations.
   e. Initial and final disinfectant residuals in ppm for each outlet tested.
   f. MFT Coliform bacteria test results for each outlet tested. (Other testing methods are not acceptable).
   g. Certification that water conforms, or fails to conform, to bacterial standards of New York State Department of Health.

C. Certificate: Certify that disinfection testing of water distribution system meets or exceeds requirements of the AWWA.

PART 2 - PRODUCTS

2.1 CHLORINATION CHEMICALS:

A. Forms of chlorine to be used for disinfection shall be as listed in AWWA C651 and shall be NSF 60 certified for use with potable water:

1. Liquid chlorine per ANSI/AWWA B301.
2. Sodium hypochlorite liquid per ANSI/AWWA B300.

2.2 DECHLORINATION CHEMICALS:

A. Chemicals to be used to dechlorinate flushing water shall be as listed AWWA C655, latest edition. Unless superseded by the latest edition acceptable chemicals include but are not limited to:

1. Sodium Thiosulfate ($Na_2S_2O_3*5H_2O$)
2. Sodium Bisulfite ($NaHSO_3$)
3. Sodium Sulfite ($Na2SO_3$)
4. Sulfur Dioxide (SO_2)
5. Sodium Metabisulfite ($Na_2S_2O_5$)
6. Calcium Thiosulfate($Ca_2S_2O_3*5H_2O$)
7. Ascorbic Acid (CH_3COOH)
8. Sodium Ascorbate ($NaCH_3COO$)

PART 3 - EXECUTION

3.1 GENERAL:

A. The Contractor shall locate blow-off valves at low points and dead ends in the grid to permit the removal of sediment.

B. The corporation stops to be used for pressure testing and chlorination shall be installed at the tap valve by the Contractor.

C. Tap for injection of chlorine shall be located to allow for one-way travel through the pipeline to the end point.

D. Source water that is from a public water supply shall use backflow protection. A double check valve assembly or better device approved by the New York State Department of Health is acceptable.

3.2 PRE-TEST FLUSHING:

A. All pipelines shall be flushed to remove the lighter solids in the line. Because flushing cannot be relied on to remove heavy material allowed to get into pipeline during installation, every precaution shall be made to protect the pipeline against entrance of foreign material during the installation process.

B. Every new pipeline shall be flushed at a minimum velocity of 3.0 feet per second (fps) to ensure that the lighter solids are removed from the pipe interior. (Note that it may be difficult to obtain scouring velocities in a pipe over two hundred (200) feet in length.) Where instances of velocity cannot be ascertained easily, Contractor, Engineer and Water Supplier shall agree on when sufficient flushing has occurred.

C. Discharge velocity can be determined by a simple field procedure involving the "trajectory" method. For any size pipe discharging horizontally three feet above the ground, a stream of water traveling at twelve (12) feet per second will strike the ground six feet away. Similarly, a stream of water traveling at five feet per second will strike the ground more than two feet from the end

of the pipe. This test must be made thru an open-ended pipe; it must not end with a valve or fitting, which would be smaller than the inside diameter of the pipe.

D. All pipelines eight inches in diameter or greater, or pipelines suspected of having heavy foreign material in them, shall be subjected to open end flushing to remove any foreign material from the pipeline. Pigging is required in addition to open-end flushing.

E. A velocity of 5.0 fps is desirable and a velocity of 12 fps may be needed to remove sand from river undercrossings and other subsurface inverts if applicable to the water main route or known deposits.

F. Table 1, provided at the end of this Specification, outlines the number and size of flushing assemblies required.

G. During the flushing process, a clean white cup shall be used at all sampling points to visually check for water clarity. When all the sample points are clear, meaning there is no background sediment, and the system chlorine residual is present, the line is ready to schedule for chlorination.

H. In the case of mains twenty-four (24) inch and larger, preliminary flushing may be replaced by stringent measures for removal of dirt and sediment from the pipe and the thorough cleaning of its interior prior to filling with the high chlorine solution. Swabbing with a chlorine solution may be required at the discretion of the Engineer. Confined space procedures shall be followed if personnel enter the pipe to perform work.

3.3 CHLORINATION:

A. Upon satisfactory completion of all testing and flushing, the Contractor shall furnish all materials and labor necessary to disinfect all water mains in accordance with the applicable sections of AWWA C-651, latest edition.

B. Prior to chlorine injection the following shall be ensured:

1. That the source water tap valve for the water mains to be chlorinated has been shut off.
2. That all blow offs and sample points involved in the Project are open
3. That there are no open valves to activate water mains tied into the water mains to be chlorinated.
4. That there is an uninterrupted supply of potable water or adequate number of barrels to assure there is no interruption once the injection process begins.

C. Disinfection of water mains shall be completed in accordance with ANSI/AWWA C651, latest edition standards and shall include the following; preflushing or cleaning of the water mains before the application of chlorine, disinfecting the mains with the prescribed chlorine dose for the disinfection method being utilized, allow for the proper amount of chlorine holding or contact time, ensuring that the applicable chlorine residual was maintained for the duration of the disinfection period, and final flushing and clearing of the heavily chlorinated water with the disposal and treatment of the heavily chlorinated water in accordance with applicable dechlorination methods.

D. All sampling points shall be at sites as designated by the approved plan.

E. Satisfactory bacteriological analysis shall be determined by the results of samples collected by the Contractor and analyzed at a New York State certified lab as required by the Department of Health.

F. The Town shall furnish the Contractor with sufficient water to perform the disinfection required. As the chlorine solution is being injected the chlorine residual at the closest sample point to the injection point shall be tested with a high Cl2 test kit or DPD reagent as applicable**.** The water flow or solution strength shall be adjusted as necessary to achieve the recommended minimum chlorine strength.

G. As the high chlorine solution reaches each successive sample point, the valve at the sample point shall be closed. Prior to closing the valve at the last sample point, the following water main shut down process shall take place in sequence:

1. The source water control valve shall be closed.
2. The injection pump should be shut off and its valve closed.
3. The last blow off/ sample point valve should be closed.

ALL BLOW-OFF VALVES SHALL NEVER BE CLOSED BEFORE THE SOURCE WATER VALVE IS CLOSED.

H. The initial chlorine solution shall be no less than 50 ppm and not more than 1000 ppm in concentration and shall be left standing in the main for a period of not less than twenty-four (24) hours and not more than forty-eight (48) hours. There must be a chlorine residual of 10 ppm at the sample point after twenty-four (24) hours. After this period, the high chlorine water shall be drained and/or flushed from the system.

3.4 POST TEST FLUSHING:

A. Draining and/or flushing the solution from the main shall be the responsibility of the Contractor and shall be performed so as not to cause damage to the environment or create a nuisance to property or environment. The Contractor shall inform the Engineer of the proposed methods of disposal of the high chlorine solution.

B. Where applicable flushed water shall be treated to remove the chlorine residual from the water being discharged that has the potential to impact storm sewer, retention pond, lake, bay, or any other body of water, chemicals for dechlorinating the water shall be as specified above. See AWWA Standard C655, for additional details. This process shall be followed each time water is discharged. The following doses are for reference only. Their use does not release the Contractor from the responsibility of achieving full dechlorination. Manufacturer’s suggested dose shall supersede the below values.

De-Chlorination Chemical	Dose in Parts (mg) required per part (mg) Chlorine at pH 8.0
Sodium Thiosulfate ($Na_2S_2O_3*5H_2O$)	1.86
Sodium Bisulfite ($NaHSO_3$)	1.61
Sodium Sulfite ($Na2SO_3$)	1.96
Sulfur Dioxide (SO_2)	0.9
Sodium Metabisulfite ($Na_2S_2O_5$)	1.47
Calcium Thiosulfate($Ca_2S_2O_3*5H_2O$)	1.19
Ascorbic Acid (CH_3COOH)	2.48
Sodium Ascorbate ($NaCH_3COO$)	2.78

3.5 SAMPLING:

A. The Contractor shall schedule bacteriological sampling through the state certified lab. The Engineer shall be present during all sampling times.

B. Before the water samples are collected, the Contractor shall ensure that all the blow off(s) and sample point(s) are opened and that the source water control valve is open.

C. Bacteriological sampling shall be conducted in accordance with New York State Department of Health regulations. Disinfection residuals shall be measured and recorded. Bacteriological samples shall be collected and analyzed on two or more consecutive business days each taken twenty-four (24) hours apart.

D. Prior to initiating sampling, a check for the Free Chlorine Residual at the last sample point is recommended to confirm that the residual is representative of the incoming source water.

E. If the Free Chlorine Residuals are satisfactory, the specialist will begin water sample collection.

F. After the sampling is completed, the Contractor shall initiate the shut down process using the following sequence:
   1. Turn off blow off(s) and sample point(s).
   2. Shut off the control valve.

G. Main Clearance Sampling is completed when each sample site has two consecutive day satisfactory (Total Coliform Absent) results.

H. Bacteriological test results for new and altered public drinking water mains will be considered invalid if the pressure in the mains is not maintained at 20 psi or greater after the samples are collected.

I. Flushing and sampling shall be repeated, as required, if total coliform is detected in a water sample. If necessary, the main shall be re-chlorinated.

3.6 ACTIVATION:

A. No section of any main shall be put into service without the written permission of the Engineer and Department of Health.

B. The water main(s) needs to be thoroughly flushed before it is actually placed into service using potable water.

C. To achieve this flushing, fire hydrants may be utilized on 6-inch and larger water mains. On water mains less than 6-inches, a permanent blow-off may be used if provided. Otherwise the temporary blow-offs setup for the flushing, chlorination and main clearance sampling procedures must be utilized.

D. Before activation, new water mains should be flushed until the water runs clean and clear. In addition, after the water main has been flushed, field tests for FreeChlorine should be taken to ensure disinfection residual. A minimum detectable level of 0.2 mg/l is required. Notify the Engineer of any discrepancies.

E. If a water main tie-in is involved or if the pressure in the main was not maintained at 20 psi or greater, notify the Engineer and water samples for bacteriological analysis should be collected.

TABLE 1

(For Information Purposes Only, Nozzles based on 40 psi Residual Pressure)

Pipe Size (NPS)	Flow (gpm) Required for 3.0 fps	Number of Hydrant Outlet Nozzles	Size (in.) of Hydrant Nozzles
4	120	1	2.5
6	260	1	2.5
8	270	1	2.5
10	730	1	2.5
12	1,060	2	2.5
14	1,440	2	2.5
16	1,880	2	2.5
18	2,380	1	4.5
20	2,940	1	4.5
24	4,240	2	4.5

TABLE 2		
(For Information Purposes Only, Chlorine Required to produce an initial 25 mg/L concentration in 100 ft of pipe)		
Pipe Size (NPS)	100% Chlorine (lbs)	1% Hypochlorite Solution (gal)
4	0.013	0.16
6	0.03	0.36
8	0.054	0.65
10	0.085	1.02
12	0.12	1.44
16	0.217	2.60

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT:

A. Measurement shall be made on the basis of lineal foot of pipe of the type and size(s) properly placed, as measured by the Engineer. Measurements shall be made horizontally along the axis of the pipe and shall include all fittings and/or accessories not specifically included for measurement and payment under other items in the Proposal.

4.2 PAYMENT:

A. Payment will be made at the unit price bid under the appropriate item(s) of the Proposal.

END OF SECTION 331301

SECTION 333113 - POLYVINYL CHLORIDE (PVC) PIPE FOR PRESSURE SEWER SERVICE

PART 1 – GENERAL

1.1 WORK INCLUDED:

A. This specification section includes all materials, equipment, labor, and incidentals required for the supply and installation of polyvinyl chloride (PVC) and molecularly-oriented polyvinyl chloride (PVCO) pipe and fittings, 4-inch diameter to 60-in diameter for use in force main, siphons, or other pressure sewer applications.

1.2 RELATED SECTIONS:

A. Trenching, Backfill and Compaction Work – Section 312333

B. Pressure and Leakage Testing of Pipelines – Section 330110.13

C. Tracer Wire: Section 330589

1.3 REFERENCES:

A. The Contractor and/or Pipe Manufacturer shall follow the standards listed below, except as otherwise specified herein. The latest revision or edition in effect at the time of bid opening shall be utilized.

1. American Society for Testing and Materials (ASTM)
    a. D1784 – Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
    b. D2241 – Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
    c. D2774 – Standard Practice for Underground Installation of Thermoplastic Pressure Piping
    d. D3139 – Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
    e. F477 – Elastomeric Seals (Gaskets) for Joining Plastic Pipe
    f. F1483 – Standard Specification for Oriented Poly(Vinyl Chloride), PVCO, Pressure Pipe
2. American Water Works Association (AWWA)
    a. C605 – Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pie and Fittings
    b. C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)
    c. C907 – Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 in. Through 12 in. (100 mm Through 300 mm), for Water, Wastewater, and Reclaimed Water Service

d. C909 – Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 in. through 24 in. (100 mm through 600 mm) for Water, Wastewater, and Reclaimed Water Service
e. M23 – PVC Pipe – Design and Installation

3. Uni-Bell PVC Pipe Association
   a. UNI-PUB-9 – Installation of PVC Pressure Pipe
   b. Handbook of PVC Pipe Design and Construction

1.4 QUALIFICATIONS:

A. The Pipe Manufacturer shall be a member of the Uni-Bell PVC Pipe Association.

B. The pipe and fittings shall be designed, manufactured, and installed in accordance with industry standards and shall comply with the specification requirements herein.

1.5 SUBMITTALS:

A. Conform to the requirements of Section 013300 – Submittal Procedures.

B. Submit product data on pipe, fittings, gaskets and appurtenances as required to ensure products meet the requirements of this specification.

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Pipe shall be shipped so as to not bend, dent, or otherwise damage the pipe during transport.

B. Contractor shall take all necessary precautions to prevent damage to pipe and fittings during delivery and unloading.

C. Owner shall observe and inspect unloading of pipe to ensure proper unloading procedures are followed.

D. Under no circumstances will pipe be allowed to be rolled, pushed, or dropped off from any height for delivery, storage, or installation. Any pipe found to have been damaged due to improper handling procedures truck will be immediately marked for identification and removed from the jobsite at the Contractor's expense.

E. Stacking of pipe shall be performed in accordance with Pipe Manufacturer's recommendations.

F. Once pipe has been unloaded, it shall be stored as near to its point of installation as possible. Contractor shall limit moving or restacking of pipe prior to installation.

G. Where necessary, because of ground conditions, store pipe on wooden sleepers, spaced suitably and of such widths as not to allow deformation of pipe at point of contact with sleeper or between supports.

H. Pipe shall not be stored close to heat sources or hot objects such as heaters, boilers, steam lines, and engine exhaust.

I. If pipe is to be exposed to direct sunlight for extended periods (in excess of two years from the date of manufacture), then Contractor shall cover/shade pipe utilizing canvas or other opaque materials. Black plastic will not be acceptable as a shading material.

J. Gaskets shall be protected from exposure to excessive heat, prolonged direct sunlight, and oil and grease.

K. Material storage shall be performed in accordance with Pipe Manufacturer's recommendations.

PART 2 – PRODUCTS

2.1 PIPE:

A. PVC pipe shall be manufactured and supplied in accordance with AWWA C900 (4-Inch to 60-Inch) or ASTM D2241 (4-Inch to 36-Inch). PVCO pipe shall be manufactured and supplied in accordance with ASTM F1483 (4-Inch to 16-Inch) or AWWA C909 (4-Inch to 24-Inch).
   1. Pipe shall have a Standard Dimension Ratio (SDR) of SDR 26.

B. Pipe shall have lay lengths between 14 and 22 feet unless otherwise specified by the Owner.

C. The pipe shall be made of PVC compound having a cell classification of 12454 in accordance with ASTM D1784.

D. Pipe shall be homogenous throughout, free of voids, cracks, inclusions, and other defects.

E. Pipe shall have markings at intervals of 5ft or less including:
   1. Manufacturer's name or trademark and code
   2. Nominal pipe size
   3. PVC cell classification
   4. Legend (e.g. " C900 PVC Sewer Force Main" or "PS 46 PVC Sewer Pipe")
   5. ASTM or AWWA Designation
   6. Gasketed pipe shall be marked with an insertion depth mark on the spigot end
   7. Production code

F. Pipe for wastewater applications shall be green or white in color.

G. Pipe outside diameters shall be equal to those of cast iron unless otherwise specified by the Owner.

2.2 PIPE DESIGN

A. Pipe shall be supplied to meet the pressure requirements of the project as follows:
   1. Working Pressure (Pw) of 160 psi
   2. Occasional Surge Pressure (Pt) of 500 psi
   3. Recurring (cyclic) Surge Pressure (Pt) of 340 psi
   4. Field Hydrostatic Test Pressure (Pft) of 100 psi

B. Pipe shall be supplied to meet the external loading requirements of the project as follows:
   1. Maximum calculated deflection of 7.5%
   2. Live loads as calculated per AWWA M23 based on the profile shown on the plans
   3. Depth of cover as shown on the plans
   4. Trench width as shown on the plans
   5. Modulus of soil reaction (E'), bedding constant (K), and soil density (γ) shall be based on design and site conditions.

2.3 FITTINGS:

A. Fittings shall be fabricated and supplied in accordance with AWWA C900. Molded fittings shall be manufactured and supplied in accordance with AWWA C907.

B. Fittings shall be made of PVC compound having a cell classification of 12454 or 13343 in accordance with ASTM D1784.

C. Pipe used in fabricated fittings shall have a wall thickness equal to or greater than the wall thickness of the pipes to which the fitting (or that part of the fitting) will be joined.

D. Molded and fabricated fittings shall have markings including:
   1. Manufacturer's name or trademark
   2. Nominal size
   3. Material designation (e.g. "PVC")
   4. ASTM or AWWA Designation

E. Fittings may also be supplied as ductile iron fittings in accordance with AWWA C110 and/or C153.

2.4 PIPE JOINTS:

A. Joints shall be gasketed push-on type conforming to ASTM D3139.

B. Gasket materials shall meet requirements of ASTM F477.

C. Joint lubricant shall be approved by the Pipe Manufacturer and shall have no detrimental effect on the gasket or pipe.

D. Restraining of joints against thrust shall be accomplished by either integral joint restraint systems provided by the Pipe Manufacturer, external restraint systems, or thrust blocking.

E. Size and type of restraint will depend on pressures, pipe size, type of fitting/appurtenance, profile, soil type, and depth of cover. Contractor shall ensure that all external joint restraint systems are installed correctly including appropriate torqueing of bolts.

F. Thrust forces will be calculated as per AWWA M23 manual.

PART 3 – EXECUTION

3.1 GENERAL:

A. Install pipe, fittings, specials, and appurtenances in accordance with AWWA C605, ASTM D2774, UNI-PUB-9 and/or in accordance with the Pipe Manufacturer's recommendations.

B. Lay pipe to the lines and grades as indicated on the Plans.

3.2 PIPE HANDLING:

A. Handle pipe and piping materials with care to avoid damage.

B. Prior to installation, each pipe length shall be carefully inspected for damage.

C. All pipe, fittings, and appurtenances shall be thoroughly cleaned before installation and shall be kept clean until installation and backfilling has completed.

D. Use only nylon ropes, slings, or other lifting devices that will not damage the surface of the pipe.

E. Keep the pipe clean and free of debris, dirt, animals, and trash during and after laying operations.

F. At the close of each operating day, seal the open end of the pipe using a gasketed night cap.

3.3 PIPE INSTALLATION:

A. Do not drag pipe over gravel or rock. Avoid striking rocks or hard objects when lowering pipe into the trench.

B. Placement of pipe and fittings into the trench should be done with ropes and skids, slings on a backhoe bucket, or by hand.

C. Pipe or fittings shall not be thrown into the trench and no part of the pipe shall be allowed to take an unrestrained fall onto the trench bottom.

D. Joint sockets shall be carefully cleaned before pipes are lowered into trenches.

E. Pipe trenches and excavation shall be kept free of water during pipe laying operations and other related work. If high groundwater levels are expected or encountered, Contractor is to ensure that a minimum depth of cover of 1.5 times the pipe diameter will be maintained over the pipe once it has been installed or provide other methods approved by the Owner and Pipe Manufacturer of preventing flotation of the pipe.

3.4 JOINT MAKING:

A. Install push-on joints in accordance with Pipe and Fittings Manufacturer's recommendations.

B. Inspect the gasket, pipe spigot bevel, gasket groove, and sealing surfaces for damage or deformation. In cases when gaskets are supplied separately from pipe, Contractor is to ensure that gaskets supplied are designed for the pipe in use.

C. Clean the gasket of all extraneous matter.

D. Apply a thin film of joint lubricant to the inside of the gasket and the outside of the spigot prior to entering the spigot into the bell. Lubricated spigots ends shall not come in contact with soil or backfill material.

E. Insert the spigot end of the pipe carefully into the bell until the reference mark on the spigot is flush with the bell. If two reference marks are present, the mark closest to the spigot end shall be considered the minimum insertion mark, and the second mark shall be considered the maximum insertion mark. Under no circumstances will the spigot be inserted into the bell past the reference mark or maximum insertion mark.

F. Small diameter pipe shall use the bar and block method for joint assembly or other method approved for use by the Owner and Pipe Manufacturer.

G. Large diameter pipe shall use mechanical assistance such as hydraulic pipe pullers, jacks, pulleys, come-alongs, or a backhoe bucket. Observation by a spotter will be required when assembling joints for large diameter pipe to prevent over-insertion.

H. When using a field cut plain end piece of pipe, bevel the end with a beveling tool, wood rasp, or power sander to the same angle and length as provided on the factory-finished pipe. Redraw the insertion line on the spigot using a factory-marked spigot as a guide.

I. Angular changes in pipe alignment shall be achieved by either fittings, joint deflection, or longitudinal bending of the pipe.

J. Joint deflection shall not exceed the Pipe Manufacturer’s recommendation.

K. Field assembly of pipe fittings shall follow the Pipe Fittings Manufacturer’s recommendations.

L. Mechanical joints shall be assembled per the Pipe and/or Fittings Manufacturer’s recommendations as well as the recommendations of the mechanical joint supplier.

3.5 LONGITUDINAL PIPE BENDING:

A. Controlled changes in direction may be accomplished by longitudinal bending of the pipe barrel.

B. Pipe Manufacturer shall be consulted prior to start of construction for recommendations on longitudinal bending.

C. When longitudinal bending of pipe is utilized, Contractor shall use manual force alone to achieve prescribed bending. Mechanical means shall not be utilized to achieve longitudinal bending of the pipe.

D. When the desired change of direction in the pipeline exceeds the maximum allowable deflection specified, the longitudinal bending shall be made throughout a number of pipe lengths.

E. Contractor will ensure that pipe joints will not be over-pulled or over-inserted during longitudinal bending operations.

3.6 FIELD TESTING:

A. All finished installations shall be pressure tested in accordance with AWWA C605 and the specifications herein.

B. Pipe shall be backfilled and braced to prevent movement during pressure testing. Testing of exposed or unburied pipe will not be permitted without the explicit approval of the Owner and Pipe Manufacturer.

C. Joint restraint at fittings should be permanent and constructed to withstand test pressure. If concrete thrust blocks are used, sufficient time must be allowed before testing to permit the concrete to cure.

D. Test ends should be restrained to withstand thrusts developed while under pressure.

E. The pipe shall be filled slowly from the lowest point on the line. Flow velocity during line filling should not exceed 1 ft/s.

F. All air should be expelled from a pipeline during filling and again before acceptance tests are conducted.

G. All fixtures, devices, or other accessories which are to be connected to the lines and which would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines are plugged or capped as required during the testing procedures.

H. Make-up water allowances shall not exceed the limits of AWWA C605. Any leaks that may occur shall be repaired in accordance with the recommendations of the Pipe Manufacturer to the satisfaction of the Owner, and the system shall be retested until no leaks are found.

PART 4 - MEASUREMENT AND PAYMENT:

4.1 MEASUREMENT:

A. Measurement shall be made on the basis of lineal foot of PVC water pipe of the type and size(s) properly placed, as measured by the Engineer. Measurements shall be made horizontally along the axis of the pipe and shall include all fittings and/or accessories not specifically included for measurement and payment under other items in the Proposal.

4.2 PAYMENT:

A. Payment will be made at the unit price bid under the appropriate item(s) of the Proposal; the price bid shall include ,excavation, shoring, dewatering, disposal, bedding, NYSDOT sub-base backfill, compaction, compaction testing, thrust blocks, retaining rods, fittings and specials, including reducers, disinfection, testing and sampling, restoration; identification tape, locating wire, record drawings, miscellaneous work, including connection to existing mains and appurtenances, abandonment of existing mains, as required to complete the work.

END OF SECTION 333113

SECTION 333113.14 - DUCTILE IRON (D.I.) PRESSURE

PART 1 – GENERAL

1.1 WORK INCLUDED:

A. Provide and install ductile cast iron pressure sewer pipe and specials, with end types (mechanical joint, flanged, push-on or ball and socket) as called for or shown with integral wall bell and spigot joints.

1.2 RELATED WORK:

A. Trenching, Backfilling and Compaction Work - Section 312333

1.3 EXISTING CONDITIONS:

A. It shall be the Contractor's responsibility to investigate all site conditions that may affect his work.

PART 2 - MATERIALS

2.1 PIPE (GENERAL):

A. All pipe shall be centrifugally cast.

B. Shall be coated on the outside and cement-lined.

C. Shall be in lengths of 16 feet to 20 feet, according to the Manufacturer's standard practice.

D. Shall be Class 51, unless otherwise indicated.

E. The weight, class or nominal thickness and casting period shall be shown on each pipe.

F. The manufacturer's mark, the year in which the pipe was produced and letters "DI" or "Ductile" shall be cast or stamped on each pipe.

2.2 DEFINITIONS:

A. "Pipe" - all straight sections

B. "Specials" - all branches, bends, tees, other fittings, reducers, etc.

C. Straight pipe which is cut to fit to work, or short sections of straight pipe, will not be considered specials.

D. All cast iron specials shall be Class 250, shall have the same type ends and shall be in accordance with the Specifications for the pipe with which they are to be placed, unless specifically indicated otherwise.

E. In general, flexible joints (mechanical, push-on or ball and socket) shall be used for outside piping and flanged joints shall be used for inside piping.

2.3 PIPE (JOINTS AND FITTINGS):

A. Mechanical Joint Pipe:

1. Joint shall meet all requirements of American Standard Specifications for Mechanical Joints, A21.11 "year of latest revision".
2. Shall have the same pressure rating as the pipe of which it is part.
3. Bell of mechanical joint shall be cast integrally with the pipe and shall meet the applicable requirements of the specifications under which the pipe is produced.
4. The iron in the glands shall meet the requirements of Class 25 of American Standard Specifications for gray iron cast, ASA G25.1, or most recent revision thereof.
5. The annular surfaces of the gland lip and the bolt circle, shall be concentric and tolerances shall be given by the American Standard Specifications for Mechanical Joints, A21.11 - 1964, or "year of latest revision".
6. The surface of the gland shall be smooth and free from defects of every nature which would unfit them for the use intended.
7. Glands shall be coated with a bituminous dip or paint, unless otherwise specified.
8. Gaskets shall be vulcanized natural or vulcanized synthetic rubber and shall be in accordance with American Standard Specification A21.11 "year of latest revision". No reclaimed rubber shall be used. When two (2) hardnesses of rubber are included in a gasket, the soft and hard portions shall be integrally molded and joined in a strong vulcanized bond. They shall be free of porous areas, foreign material, and visible defects. Tests shall be made by the manufacturer in accordance with the applicable ASTM Test Methods. Gaskets shall be Rainbow, Durable, Garlock or approved equal.
9. The mechanical joint for ductile iron pipe shall meet all the requirements of the American Standard Specifications for Mechanical Joints, A21.11 "year of latest revision", and shall have the same pressure rating as the pipe of which it is a part.
10. The bell of the mechanical joint shall be cast integrally with the pipe and shall meet the applicable requirements of the specifications under which the pipe is produced.
11. Fittings shall be ductile iron or gray iron mechanical joint conforming to ANSI Standard A21.10.

B. Push-On Joint Pipe:

1. Joint shall meet all requirements of ANSI A21.11 "year of latest revision" (AWWA C111) for the rubber gasket joints.
2. All joints shall be provided with two (2) serrated bronze wedges in accordance with the pipe manufacturer's standards. Wedges shall insure electrical conductivity throughout the entire length of pipeline.
3. Fittings shall be ductile iron or gray iron mechanical joint type conforming to the requirements of A21.10. Push-on fittings shall not be permitted.

C. Flanged Pipe:

1. To be provided where specifically indicated on the Plans or called for in the Specifications.
2. Shall be of the water pattern, as under American Standard Association Specification 3.6.1, Class 125 or Class 250 (as indicated), latest revision.
3. Shall conform to ANSI A21.10 (latest revision).
4. All flanged pipe ends and fittings shall be faced and drilled in accordance with the aforementioned standard.
5. The gasket material, bolts and nuts, and all other items necessary to provide a complete installation of flanged pipe and fittings shall be provided and included.

D. Ball and Socket:

1. To be provided where specifically indicated on the Plans or called for in the Specifications.
2. Shall be suitable for usage on the water system shown.
3. Joints shall be boltless, push-on, with bayonet-type locking retainer and capable of deflections to a maximum of 15 degrees.
4. Joint bell, ball and retainer shall be of cast 70-50-05 ductile iron in accordance with ANSI A21.20 (year of latest revision).
5. Pipe components shall be machined to precise tolerances to assure premium performance and ease of assembly.
6. Gasket shall be of high quality rubber and symmetrical to insure it cannot be installed backwards.
7. Pipe shall be ductile iron of cast 60-42-10 in accordance with ANSI A21.51.
8. Pipe shall be of the thickness class number to overcome buoyancy.
9. Pipe shall be cement-lined, bituminous coated, 18'lengths and conform to all other requirements under this section, unless otherwise noted.

2.4 STANDARDS:

A. All pipe and fittings shall at minimum meet all the applicable requirements of the American Water Works Association (AWWA).

B. Pipe shall conform to American National Standard for Ductile Iron Pipe, Centrifugally Cast in Metal Molds, for the water or other liquids of AWWA Specification C151-78.

C. All the ductile cast iron pipe and fittings shall be cement-lined in accordance with "American Standard Specifications for Cement Mortar Lining for Cast Iron Pipe and Fittings, A21.4 "year of latest revision" or AWWA C104.

D. Bituminous seal coat shall be applied over the cement lining as specified in A.S.A. Specification A21.4 "year of latest revision".

PART 3 - CONSTRUCTION DETAILS

3.1 GENERAL:

A. All pipe and fittings shall be placed as shown on the plans and in compliance with the requirements of the specifications.

B. All pipe shall be installed and assembled in accordance with the manufacturer's recommendations.

3.2 INSPECTION OF PIPE:

A. Previous to being lowered into the trench, each pipe and fitting or coupling shall be carefully inspected, and those not meeting the specifications shall be rejected and immediately removed from the project site and replaced with acceptable materials. Such replacement shall be made at no cost to the Owner.

B. Movement of construction equipment and all other vehicles and loads over and adjacent to any pipe shall be done at the Contractor's risk. Any pipe, which in the judgement of the Engineer is damaged or disturbed through any cause, shall be replaced at the expense of the Contractor and at no cost to the Owner.

3.3 PIPE PLACEMENT (GENERAL):

A. Pipe lines shall be placed in the locations and grades as indicated on the Plans and in conformance with this Specification.

B. Trenches shall be kept free from water, and no pipe shall be laid in water.

C. Pipe shall be so laid as to be evenly supported throughout the whole length of the barrel, with no weight resting on the bell or coupling. "Bell holes" shall be provided so that bells or couplings of pipe hang free.

D. If the trench is dug deeper than the grade of the barrel, no spalls, shims or lumps shall be used to raise the pipe to the grade, but an even bed shall be formed of sand or accepted fine material properly tamped at no additional expenses to the Owner.

E. In all cases where piping is being installed below the ground surface, before leaving the work for the night or any other time, the end of the pipe shall be securely closed with a tight-fitting plug, and sufficient backfilling placed to protect the pipe.

F. When pipe is under pressure, and as indicated by the Engineer, reaction or thrust blocks shall be applied on all pipe lines size four (4) inches in diameter or larger at all tees, plugs, caps, and joints deflecting 22-1/2 degrees or more.

G. Tie rodding shall be done using pipe clamps manufactured for this purpose with minimum of 2-3/4" diameter steel rods. All costs of furnishing and placing such thrust blocks or tie rods shall be at the expense of the Contractor, and shall be included in the price bid under these items.

3.4 PIPE PLACEMENT (FOUNDATION):

A. All pipe shall be laid on a foundation of compacted Crushed Stone Foundation to the minimum dimensions noted on the detail on the Plans.

B. If in the opinion of the Engineer the subgrade will not properly support the pipe, additional crushed stone material shall be provided as necessary to provide a firm pipe bedding as acceptable to the Engineer.

C. Ground conditions such as quick sand, other soft and yielding or otherwise unsuitable material shall be immediately brought to the Engineer's attention such that evaluation of the necessary bedding can be made.

D. The Contractor is advised that additional crushed stone foundation material shall only be placed where required for the Engineer's acceptance of the work.

E. All Crushed Stone Foundation material shall conform to the requirements of the applicable technical section of the Specifications.

3.5 PIPE PLACEMENT (LOCATION & GRADE):

A. The pipe or invert grade referred to in the specifications and as indicated on the plans is the lowest point of the pipe invert or flow line.

B. Pipe shall be placed in the location and at exactly the lines and grades indicated on the plans.

C. The Engineer shall have the power to require the removal or relaying of any pipe laid contrary to the plans during his absence or that of his assistants or the Project Representative from the project site.

D. Grade or alignment shall not be disturbed by the operation of tamping or backfilling. Care must be taken not to disturb the pipes by stepping on or near them, or by throwing earth on them from the bank or otherwise.

E. The pipes and fittings or couplings shall be so laid in the trench that after the line is completed the interior surface thereof shall conform accurately to the grade and line required by the Engineer, and as indicated on the Plans.

F. Contractor must transfer line and grade to "batter boards" and string line over the trench. The Contractor may not transfer line and grade to and/or utilize a "side line" or string set to line and grade other than over and above the center line of the pipe to be laid.

G. Other methods of Grade and Alignment control are subject to acceptance by the Engineer.

3.6 PIPING JOINTS:

A. Mechanical:

1. Joints shall be installed in full conformance with the manufacturer's recommendations.
2. Spigot end of the pipe shall be thoroughly brushed with a wire brush and then the gasket

and spigot end of the pipe shall be brushed with soapy water. Cast iron gland shall then be slipped on the spigot end of the pipe with lip extension toward the joint. The gasket shall then be slipped on with the thick edge of the gasket toward the gland. The bell end of the joint shall then be thoroughly brushed and the pipe inserted into the bell. The gasket shall then be pushed into position so that it is evenly seated in the socket of the bell. The gland shall then be moved into position against the face of the gasket. Bolts shall then be inserted, the nuts placed, and made up tightly with the fingers. Nuts shall then be tightened gradually, half turn at a time, using a torque-limited wrench of suitable size for the bolt sizes used, moving it from one nut to another and repeating until all nuts are uniformly tight. Torque limits of the bolts shall be in accordance with the pipe manufacturer's recommendations.

3.7 TESTING:

A. Time for Testing:

1. In general, piping shall be tested prior to placement of paving materials. Paving prior to testing and acceptance of the piping shall be at the Contractor's risk.
2. Testing shall be performed at as late a date as possible, after work has been completed and a time period for settlement has had a chance to occur.
3. In no instance shall sewers be tested prior to completion of construction work in the area, nor prior to two (2) weeks after installation of the piping.

B. Procedures for Testing:

1. After the sewer pressure mains have been installed and before pipe joints, fittings, valves or other appurtenances are covered, all of the excess air shall be expelled and the main shall be pressure tested.
2. Under the pressure test, hydrostatic pressure shall be equivalent to a pressure of 50% above normal operating pressure, based on the elevation of the lowest point on the line or section under test and corrected to the elevation of the test gauge.
3. In no instance shall the pipe lines be tested for more than 175 psi.
4. The pressure test shall be at least two hours in length, preferably before complete backfilling of the pipeline, when the joints are exposed.
5. All visible leaks, any cracked or defective pipe, fittings, valves, or hydrants discovered in consequent of the pressure test shall be removed and replaced by the Contractor with sound material; and the test shall be repeated until results satisfactory to the Engineer are obtained.
6. The Contractor shall perform low-pressure air tests in conformance with ASTM C-828 (latest revision), entitled "Recommended Practice for Low-Pressure Air Test of Vitrified Clay Pipe Lines (4-12)". The parameter to be measured is the rate of a loss based on an average test pressure of 3.0 psig above any back pressure due to any groundwater that may be over the pipe.

C. Other Testing Requirements (General):

1. All testing shall be performed with a representative of the Engineer and/or Owner present.
2. The Contractor shall give ample notification of his intended test date such that observation scheduling can be made. Any delays and associated costs caused by the

Contractors failure to schedule the attendance of necessary representatives shall be borne by the Contractor.

3. Length and location of sections to be tested, duration of test, and other requirements shall be acceptable to the Engineer.
4. All evident leaks shall be investigated and the necessary repairs made, and leakage minimized regardless of total leakage as shown by test.
5. Lines which fail to meet tests shall be repaired and retested as necessary until compliance with test requirements. Defective pipe and branch connections shall be removed and replaced.
6. All materials and equipment, cooperation and assistance necessary to perform the tests specified herein to the satisfaction of the Engineer or his duly authorized agent shall be borne by the Contractor.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT:

A. Measurement shall be made on the basis of lineal foot of ductile iron sewer pressure pipe of the type and size(s) properly placed, as measured by the Engineer. Measurements shall be made horizontally along the axis of the pipe and shall include all fittings and/or accessories not specifically included for measurement and payment under other items in the Proposal.

4.2 PAYMENT:

A. Payment will be made at the unit price bid under the appropriate item(s) of the Proposal; the price bid shall include excavation, crushed stone foundation, backfill in a manner acceptable to the Engineer, including all labor, materials, fittings, equipment, testing, all "specials" and appurtenances as required to complete the work.

END OF SECTION 333113.14

SECTION 333213 – PLANT WATER PUMP STATION

PART 1 - GENERAL

1.0 SCOPE OF WORK

A. PACKAGED PUMP STATION

The Packaged Pump Station supplier shall provide an END-SUCTION CENTRIFUGAL SELF PRIMING, non-potable water pump station complete with pumps, piping, valves, sensors, Variable Frequency Drives, programmable logic controller (PLC), UL 508A listed control panel, and all appurtenances necessary for a complete and functioning pumping system.

The pump station—including the pump control panel—shall be designed and manufactured within the confines of a UL 508A, UL QCZJ, & ISO 9001:2015 certified facility. Electrical connection, by purchaser, shall consist of a single conduit from owners disconnect to the pump station main disconnect. Packaged pump station supplier shall have certified factory trained technicians within 100 miles of project location. The service technician will be available no more than 48 hours after the time of the initial call. The packaged pump station manufacturer shall have 24-hour, on-call service lines and the ability to remotely make changes and troubleshoot.

B. FACTORY TESTING

The pump station manufacturer shall conduct and document a complete factory dynamic test of the pump station prior to shipment. Pump stations shall be tested throughout the entire operating range at the net discharge pressure called for in the technical specifications. Individual pump pressure, flow, RPMs, volts, amps, KW, and power factor shall be documented for verification by the Owners' Representative prior to delivery upon request.

1. Hydrostatic Testing. The packaged pump station shall undergo hydrostatic testing that meets ANSI/HI specifications and standards.
2. Vibration Testing. The packaged pump station shall undergo vibration testing that meets ANSI/HI 9.6.4—Vibration Measurement and Allowable Values—specifications and standards.
3. Flow Testing. The packaged pump station shall undergo Hydraulic Performance Acceptance testing that meets ANSI/HI 14.6 specifications and standards.
4. Wet Test. The entire pump station shall be completely wet tested at the manufacturing facility prior to shipping.

C. ONSITE PUMP STATION START-UP

Technical start-up shall be furnished by the Packaged Pump Station Manufacturer or a qualified service agent. Location and mounting details shall be furnished by the Packaged Pump Station Manufacturer.

Electrical connection, by purchaser, shall consist of a single conduit from owners disconnect to the pump station main disconnect. Additional purchaser responsibility shall include confirming correct motor rotation and securing local inspection/approval.

Technical start-up procedures by the pump station technician shall include the following:

1. Station start-up and pressurization.
2. Pressure, flow, and programming adjustments.
3. Monitoring of complete operational cycle when possible.
4. Testing of all alarms and fault conditions.
5. System automation tuning for field conditions.
6. Customer training and the presentation of the station operation and maintenance manual.

D. WARRANTY

The Manufacturer shall warrant the original buyer that the packaged pump station shall be free from defects in material and workmanship for a period of twelve (12) months from the date of placing the Equipment in operation or fifteen (15) months from the date of completion of manufacture of the Equipment, whichever shall occur first. The Manufacturer shall provide a 25-year rust-through corrosion warranty on the piping and skid base for Hot Dipped Galvanizing.

E. SUBMITTALS

Submittals shall be well organized, labeled, and presented in a professional manner. Sloppy or poorly presented submittals shall be rejected. The pump station manufacturer shall submit the following items as part of a complete submittal package:

1. Shop Drawings, including 3D models of the proposed pump station. The manufacturer shall also provide digital models that can be viewable from any angle.
2. Electrical Schematics
3. Control Panel Layout Drawing
4. Manufacturers complete packaged pump system UL category QCZJ file number.
5. Technical data sheets for all major system components, including:
    a. Pump performance curves and datasheets
    b. Control Panel Components: VFD, PLC, Touchscreen Interface, Panel Enclosure, & UL 508A Certification
    c. Powder Coating Data
    d. Galvanizing Data
    e. Valves
    f. Instrumentation

F. OPERATIONS AND MAINTENANCE MANUAL

An electronic operation and maintenance manual shall be furnished at the time of start-up and initial training. The owner shall also receive training specific to the pump station. Operation and maintenance instructions shall contain the following as a minimum:

1. Complete operating instructions, including HMI screenshots with detailed instructions on adjust system parameters and settings.
2. Service and Maintenance instructions.
3. Equipment and driver nameplate data.
4. Electrical schematics.
5. Factory start-up and test data, including pump curves.

1.1 MANUFACTURER QUALIFICATIONS

A. Single Source Responsibility

The entire pump station and the control panel shall be designed, assembled, programmed, and tested by a single manufacturer.

B. Certifications

The Manufacturer shall be a UL QCZJ Listed Packaged Pump Station Manufacturer, a UL 508A Listed Control Panel Manufacturer, and an ISO 9001:2015 Certified Manufacturer. The Manufacturer shall provide a Certification signed by the owners providing free phone technical support for the lifetime of the product.

C. Manufacturer Personnel

The Manufacturer shall employ service personnel who are trained and certified in every aspect of service that may be required at the pump station. It shall not be acceptable for the control panel to be designed, manufactured, programmed, or tested by any entity other than the Packaged Pump Manufacturer.

D. Approved Manufacturer

The pumping system shall be manufactured by Precision Pumping Systems of Boise, Idaho—or approved equal. To be considered an equal manufacturer, proposed manufacturers shall meet the above conditions shall submit the following:

1. Shop Drawings of Mechanical System
2. Theory of Operation
3. Installation List of 10 similar pumping systems which have been in operation for a minimum of 3 years.
4. Process & Instrumentation Diagram
5. Electrical Schematics: One-line diagrams shall not be accepted. A full-color, diagrammatic wiring schematic required.
6. Control Panel Layout Drawing
7. Technical data sheets for all major system components, including:
    a. UL QCZJ Certification, UL 508A Certification, and ISO 9001:2015 Certification
    b. Pump performance curves and datasheets
    c. Control Panel Components: VFD, PLC, Touchscreen Interface, Panel Enclosure, and Cooling Method.
    d. Powder coating or Hot Dipped Galvanizing.
    e. Valves
    f. Filtration
    g. Instrumentation
    h. Pump station enclosure

1.2 REFERENCE STANDARDS

A. NEMA – National Electrical Manufacturers Association
B. NEC – National Electrical Code
C. UL – Underwriters Laboratories, Inc.
D. AWWA – American Water Works Association
E. ANSI – American National Standards Institute
F. ANSI/HI – American National Standards Institute/Hydraulic Institute
G. ASTM – American Society of Testing & Materials

PRODUCTS

1.0 PUMPS AND MOTORS

A. END-SUCTION CENTRIFUGAL PUMPS

1. Horizontally mounted, single stage, end-suction centrifugal pumps shall be designed for continuous operating service and shall have a continuously rising performance curve.
2. The pump(s) shall meet the following design criteria;
   a. Design Flow Rate: 645 GPM @ 80 PSI
   b. Horsepower: 60 HP
   c. Minimum Power : 480 Volt / 3 Phase
   d. Pump Size: 3 x 4 – 10
   e. Installation: Close Coupled
   f. Frequency: 60 Hz
   g. Poles: 2
   h. Service Factor: 1.15
3. Construction. The pump casing shall be constructed of close grain cast iron with replaceable wear ring. All casing sections shall have heavy wall thickness to provide long life under abrasive and corrosive operating conditions. Casing shall be capable of withstanding a hydrostatic pressure test of at least 125 percent of shutoff pressure or 150 percent of design head. Piping connections shall be ASA 125# flat face drilled flange. All pumps shall be of a back pull-out design so that the rotating element can be removed from the casing without disconnecting the suction or discharge piping.
4. Impeller. Pump impellers shall be constructed of bronze, fully machined on all exterior surfaces, and statically balanced.
5. Seal. Shaft seal shall be a mechanical seal with NI-resist stationary seat, carbon washer, Buna rubber flexible members, and 18-8 stainless steel metal parts and spring.
6. Manufacturer. Pumps shall be manufactured by Xylem or approved equal.
7. Motors:
   a. Motors shall be a standard ODP IP55 NEMA type, induction style, premium efficient, and inverter duty suitable for variable speed operations per NEMA MG1 Part 31.4.4.2.

b. Motor frame shall be steel or cast iron, aluminum shall not be permitted.

c. Motors shall be rated for operation at 208-240/480 VAC, 3 phase, 60 hertz, and service factor of 1.15 or greater.

d. Duty Pump Motors shall be 3,600 RPM maximum.

e. The motor shall be of proper size to drive the pump at any point on the operation curve without exceeding the percent of the motor horsepower nameplate rating.

1.1 MECHANICAL SYSTEM

A. GENERAL REQUIREMENTS

1. System manifold and appurtenances shall be engineered such that each joint is a union, with all fittings and pipe sections removable without cutting or welding. All piping, fittings, and valves shall have roll-formed grooved connections, with grooved flange adapters provided where connecting to flanged equipment.
2. For ease of maintenance and replacement, each mechanical component, including all fittings and spools, shall include unique part numbers and shall be of a standardized design per ISO 9001:2015.
3. Threaded connections in the piping network are not acceptable.
4. No piping shall be welded to the skid base.

B. PIPING AND FITTINGS

1. All piping, fittings, and pipe supports shall be constructed of 304 stainless steel.
2. All process piping and fittings shall have a CLASS D pressure rating.
3. Manifolds shall be grooved, or cope welded per AWWA standards. Grooved couplers shall be 304 Stainless Steel. All welded flanges shall be Class D forged stainless-steel slip-on or welded neck type. All welded fittings shall be seamless, conforming to ASTM Specification A234. Threaded connections in the piping network are not acceptable.

C. STATION BASE

1. The system base frame shall be structurally engineered to provide rigid support for the entire pumping system equipment, including but not limited to pumps & motors, manifold, valves, control panel, and station enclosure. The base frame shall enable the entire pump station to withstand all stresses related to transportation, installation, and operation as carried out by qualified personnel.
2. The base frame shall be press-brake formed and fabricated ASTM A36 Steel plate with a minimum thickness of 3/16 inch. The legs of the frame shall be press-brake formed with a minimum riser height of 4 inches and shall include lifting eyes for site offloading and installation, as well as a bent flange with 3/8-inch bolt holes for on-site anchoring to a concrete pad. The frame shall be structurally reinforced with 3/16-inch-thick ASTM A36 Steel Flat Bar skip-welded to the underside of the frame.
3. The frame deck shall include an integral level sensing equipment access cap.
4. After all fabrication has been completed, the entire base frame shall be grit-blasted to bare steel and HOT-DIP GALVANIZED per ASTM-123 Standards. No welding shall be performed after the base frame is galvanized.

5. Open rail type structural support systems shall not be accepted.
6. Station frame shall have forklift slots for transportation.
7. Drain shall be provided on skid and plumbed to outside of skid.
8. Proposed alternate systems with base frame coatings that are not warrantied for 25 years shall not be accepted.

1.2 PUMP STATION ENCLOSURE

A. The pump station enclosure shall be constructed of marine grade aluminum, with all surfaces coated in thermosetting epoxy powder coating with a minimum thickness of 3 mils. The enclosure shall be suitable for outdoor use, providing protection from wind-blown rain and dust, as well as preventing ice formation.

B. The enclosure shall consist of a frame built out of structural folded aluminum. The aluminum panels shall be mounted to the enclosure frame with pan head Torx tamper resistant stainless-steel screws.

C. Enclosure shall consist of 2 hinged minimum, lockable entry doors, with SCE-41 Grade Neoprene gasketing with aggressive rubber-based adhesive. The enclosure shall have a removable roof; it shall be sloped to prevent moisture build-up, and it shall include a brake-press formed drip-edge, aluminum flashing, and SCE-41 Grade Neoprene gasket with aggressive rubber-based adhesive.

D. Enclosure Accessories

1. Insulation

The enclosure shall be insulated with rigid foam plastic thermal insulation board composed of polyisocyanurate foam core bonded to reinforced aluminum foil facers on each side. The insulation shall be 1″ thick, with an R-Value of no less than 6.0.

2. Heater – 500 WATT

The enclosure shall be equipped with a 500-Watt radiant heater with stainless steel element, built-in snap-action thermostat, and steel housing with baked enamel protective coating. It shall come equipped with a capillary tube running the full length of the element to provide over-temperature protection, which shall automatically reset when temperature drops.

3. Building Temp Sensor

The enclosure shall be equipped with a 4/20MA temperature transmitter. The sensor shall be housed in a Nema1 Plastic Enclosure. The sensor shall be capable of temperatures between -50 to 150 degrees Fahrenheit. The sensor shall be capable of User Adjustable Alarms, High Temp Alert and Low Temp Alert.

1.3 VALVES

A. Butterfly Isolation Valves – Wafer Type

Provide isolation valves as shown on the drawing. Valves shall be butterfly type with Wafer connections, Cast Iron Body, Ductile Iron Disc, EPDM Seat, 400 SS Valve Stem, and Hand-wheel Gear-Operators with 10-position indicator. Valves have a maximum pressure rating of 200 PSI.

B. Wafer Check Valves

A spring-loaded non-slam type check valve shall be installed on the discharge of each pump. The valve shall be wafer style typed fitted between two flanges. The head loss through the check valve shall not exceed 5 PSI at the pump design capacity. Check valves shall be Val-Matic 1400A series or approved equal.

C. Air Vent Valves

Air relief valves shall continuously discharge entrapped air in the system and shall be constructed of a cast iron body with stainless steel float and trim. The discharge shall be piped to the floor drain. Air vent shall have a maximum working pressure of 175PSI. Air relief valves shall be manufactured by Val-Matic or approved equal.

D. Diaphragm Style Pressure Relief Valve

The valve shall protect the piping network by bypassing or relieving excess pressure and shall maintain close pressure limits without causing surges. If upstream pressure decreases below the spring setting, the valve shall close. Relief piping shall be plumbed to the system wet well. The valve shall be a Cla-Val Co. Model No. 50-01/650-01 Pressure Relief and Pressure Sustaining Valve as manufactured by Cla-Val or approved equal.

1.4 INTAKE H-STYLE STRAINER

A. General Requirements

1. The station shall include an H-style strainer for low pressure drop applications, made with ductile iron NSF/ANSI 61 fusion bonded epoxy coated construction and 316 stainless steel strainers. H-style strainer must be serviceable without removal from the line.
2. The H-style strainer shall be CLA-VAL X43H series or approved equal.

1.5 INSTRUMENTATION

A. Pressure Gauges

Pressure gauges shall be located as shown on the technical drawing. Pressure gauges shall have a 304 stainless steel case and bezel construction. Gauges shall be 2.5” diameter, liquid filled. Pressure sensing connection shall be 1/4" NPT lower gauge connection.

B. Pressure Transmitters

The station shall have pressure transmitters located as shown in the technical drawing. The pressure transmitters shall provide noise free, linear output that is proportional to pressure. Transmitter shall be solid-state, strain gauge type with integral voltage regulation and output accuracy not less than 0.4%. Transmitter shall be constructed of stainless steel and rated for the pump station discharge pressure called out in the technical specifications. The pressure transmitter shall be manufactured by IFM or approved equal.

C. Wet Switch

1. The wet switch shall be 316L stainless steel with ½” NPT connection, IP68 rated and have two switching outputs with overload protection.
2. The wet switch shall be Efector160 series or approved equal.

D. Level Transmitters

A solid-state level transmitter shall provide a noise free, linear output proportional to reservoir level. Transmitter shall be solid-state, strain gauge type with integral voltage regulation and output accuracy not less than 0.25%. Transmitters shall be constructed of stainless steel.

E. Low Water Float Switch

The system shall have a float switch to be used to signal the pump station to shut down if the intake source water level becomes too low. The switch shall work in conjunction with the PLC (programmable logic controller). In the event the supply drops below a safe operating level, the PLC will shut down the pump system. The PLC shall be programmed to attempt to restart the pumping system two times. If after two attempts the water supply is still too low, the system will require a manual reset. The Low Water Float switch shall be 2900 Mercury series manufactured by Conery or equal.

F. Insertion Type Flow Sensors

1. The pump station shall have a non-magnetic flow sensor located as shown on the technical drawing. By using the system operator interface, an operator shall have access to flow meter data—including current flow rates and total gallons pumped—as well as adjustable settings for flow meter calibration and system flow fault setpoints.
2. The flow meter sensing mechanism shall be a six-bladed impeller.
3. The flow meter shall read flows from 0.5 - 30 fps, with a worst-case inaccuracy of +/-1.0% of reading with +/- 0.3% repeatability.
4. The meter shall be fully tested during the pump station full run performance testing while at the factory prior to shipment. The flow sensor on the pump station shall be calibrated against a master meter.
5. The flow meter shall be Badger Series 200 or equal.

1.6 PRESSURE TANK

A. The pump station shall include a 62 GALLON pre-pressurized diaphragm-type well tank. Tank shall be factory pre-charged. It shall be constructed of a steel shell and have a stainless-steel system connection. Manufactured by WELL-X-TROLL or equal.

1.7 MOTOR CONTROL PANEL

A. General Requirements

1. The Motor Control Panel shall incorporate all circuits and necessary protections required to operate the pump station, including motors, controls, and heating and ventilation circuits. All wiring shall conform to NEC and UL 508A standards for safety.
2. The control panel shall be designed, built, tested, and UL 508A listed by the pump station manufacturer. The control panel shall be UL labeled as an "Enclosed Industrial Control Panel". The pump control panel shall be completely manufactured, tested, and programmed prior to delivery to the job site.
3. Electrical connection, by purchaser, shall consist of a single conduit from owners disconnect to the pump station main disconnect.

4. The control panel shall be installed inside the pump station enclosure. Control panels mounted outside of the pump station enclosure shall not be accepted.
5. The following shall be permanently affixed to the inside of the control panel enclosure:
    a. A full-color, diagrammatic wiring schematic.
    b. Pump and motor nameplate information.
    c. Factory calibrated control setpoints.

B. Panel Construction

The pumping station electrical controls, including variable frequency drives and operator interface, shall be housed in a NEMA 4X enclosure.

1. The enclosure shall be fabricated from 304 stainless steel, 12 gauge minimum, brushed finish.
2. All internal components of the enclosure shall be mounted on a removable sub-panel, which shall be powder coated white. Mounting screws for components shall not be tapped into the enclosure wall.
3. The electrical panel doors shall be removable and interchangeable, with concealed hinges and integral latches. Door gasket seals shall be oil-resistant and shall be sufficient to protect interior components from weather and dust.
4. All external operating devices shall be dustproof and weatherproof.
5. No pressure gauges, pressure switches, water activated devices, or water lines of any sort shall be installed in the control panel.
6. MCP Temperature Regulation
    a. The PLC shall monitor the internal temperature of the control panel using an internal temperature probe. The controller shall automatically fault or send an alarm when the internal temperature reaches user adjustable high/low temperature settings.
    b. The cooling system shall interface with the pump station controller for alarms and notifications.
    c. The cooling system shall be sized for local maximum ambient conditions, plus component cooling requirements. Cooling should be designed such that the internal panel temperature does not exceed 104F.
    d. Control panel temperature regulation shall be via a self-contained, closed loop AC cooling unit. The cooling unit shall utilize compressor-based refrigeration technology with two independent air paths – one which circulates enclosure-side air across the evaporator to displace unwanted heat within the enclosure, and one which circulates ambient air across the condenser to transfer waste heat to the ambient environment.
    e. The cooling Unit shall be NEMA 4X listed and constructed with 316 stainless steel.
    f. AC Units shall include a mechanical thermostat, digital temperature display, R134A earth-friendly refrigerant, and a cleanable & reusable aluminum mesh coil-protection filter.
    g. The cooling unit shall be Hoffman Spectra cool series or approved equal.

C. Service Rated Main Disconnect

A three-pole, main station disconnect shall be contained within the control enclosure. The main disconnect shall be non-fused and isolate all power to the control enclosure. The main disconnect shall have an operating handle mounted in the enclosure door, mechanically interlocked to prevent entry while disconnect is in the ON position.

D. Control Transformer

The control transformer shall provide 120-volt power to the pump station controls. The control transformer shall be protected on the primary side with appropriately sized fuses. The secondary side shall be protected by a group of supplementary miniature circuit breakers.

E. Surge Protection

The control panel shall include an industrial grade surge protective device with individual thermally fused and protected MOVs. The surge protector shall provide 50kA per phase protection and shall be UL Listed 1449 for Type 1 SPD applications.

F. Secondary Control Circuit Breakers

Single-pole secondary distribution breakers with appropriate ratings shall supply power to each pump starter coil circuit, and control system.

G. Door-Mounted Pilot Devices

1. General Requirements

   All devices shall be IP66 rated, providing complete protection from dust, as well as complete protection from high pressure water jets from any direction.

2. Motor Selector Switches

   An HOA switch shall be provided for each motor circuit. Switches shall be modular, 3-position maintained, illuminated with green light, and include chrome metal bezel.

3. Speed Potentiometer

   A speed potentiometer shall be provided for manual speed control of VFD driven motors. Potentiometer shall be a modular knob-type with chrome metal bezel and rated 5 kOhm.

4. Pilot Lights

   System status indicating lights shall be provided, with a red light to indicate system faults and a green light to indicate when a pump is running. Lights shall be 22mm diameter and equipped with a light diffusing lens.

H. Uninterruptable Power Supply (UPS)

1. UPS shall be provided as a standby unit to support during short times when the power may be interrupted.
2. UPS shall provide a 24V output.
3. Manufacturer – PULS Model UB 10.241

I. Variable Frequency Drives (VFDs)

1. Provide a dedicated VFD for all Motors.

2. Variable Frequency Drive(s) shall be mounted inside the control panel enclosure, with each VFD isolated from main input power by use of a contactor to protect the VFD from power outside of tolerances.
3. The variable frequency drive shall be IGBT based with selectable carrier frequency up to 15 KHZ. The VFD shall include terminals for incoming power, motor output power and control terminals. All VFDs shall include an RS485 port built-in to the VFD for dedicated communication to the PLC.
4. The VFD shall generate a sine-coded, variable voltage/ frequency, three phase output for optimum speed control. The VFD shall incorporate power loss ride-through for a minimum of 2 seconds. VFD protective features shall include current limit, auto restart, short circuit protection, electronic motor overload protection, and ground fault protection. The VFD shall have a push button programming display for easy access to operation parameters. The VFD shall be protected on the primary side by a breaker of the appropriate amperage.
    a. Overload capacity: 120% rated output current for one minute.
    b. Voltage fluctuation: +10%, -15%.
    c. Sine wave, PWM, with full range, and automatic torque boost.
    d. Frequency control range: 0 to 500 Hz.
    e. Frequency accuracy: digital, 0.01 Hz, analog, .1%. Motor overload protection, instantaneous over current of 180% of rated output current.
    f. Over voltage at 820vdc if 460v input.
    g. Under voltage shall be user adjustable.
    h. Momentary power loss: up to 2 second ride through.
    i. Electronic ground fault.
    j. Led capacitor charge indicator.
    k. Input phase loss alarm.
    l. Ambient temperature ranges of 0 to 40 degrees c.
    m. Humidity of 95% non- condensing allowed.
5. Manufacturer: ABB ACQ580 with ISO 9001 certification or pre-approved equal.

1.8 PUMP SYSTEM CONTROLLER

A. General Requirements

1. Non-Proprietary, Open-Source Programming

   To better facilitate owner access to system servicing, the control system shall be non-proprietary and open source. Proprietary control systems shall not be accepted.

2. Controller User Guide

   The pump station manufacturer shall supply an owner's manual in digital form that includes graphic images of all touch screens, complete with explanations of all settings and modes.

3. Controller Technology

   The system shall be capable of sending alerts and warnings via a cellular modem.

B. Programmable Logic Controller (PLC)

1. PLC shall consist of a central processor with built-in dual port Ethernet and USB connection. Processor shall be capable of expanding up to 4 I/O expansion modules and include the following features:
    a. High-speed counter with 100 kHz maximum input frequency
    b. Pulse output with 100 kHz maximum output frequency
    c. Supply Power shall be 24V DC with a maximum 35A inrush current.
    d. Environmental Ratings
        1) Class 1, Division 2 Hazardous Location
        2) Operating Temperature: -25 to 65 degrees Celsius
        3) 10 – 95% Relative Humidity
    e. Program Storage
        1) Serial Flash Memory using embedded SD Card Slot
        2) RAM Backup via lithium battery capable of up to 4 years battery life.
    f. Communications Interface
        1) 1-USB Mini-B USB Standard 2.0
        2) 2 Ethernet Ports with RJ45 Connector
        3) Protocols
            a) Modbus TCP
            b) Modbus RTU
            c) Ethernet/IP
            d) BACnet
2. Manufacturer/Series
    a. IDEC MicroSmart FC6A Plus

C. Operator Interface

1. General Requirements
    a. The touchscreen shall allow operator access to all system settings and monitoring data.
    b. The operator interface shall be a Color TFT LCD touchscreen.
    c. The touchscreen shall be mounted to the motor control panel door.
    d. A VFD control keypad is not an acceptable substitution for the digital operator interface.
    e. The operator interface shall allow the user to adjust the system parameters & settings to the PLC program locally without requiring any additional equipment such as a laptop computer.
    f. System must be capable of programming VFD’s via touchscreen (for 3-phase systems only)
2. Hardware Features
    a. High Resolution Display with 640 x 480 pixels, with a minimum screen diagonal length of 7.0″.
    b. Backlight with 100,000 hours

c. Supply Power shall be 24V DC with maximum 30A maximum inrush current.

d. Environmental Ratings

1) NEMA 4X

2) Class 1, Division 2 Hazardous Location

3) Operating Temperature: -20 to 60 degrees Celsius

4) 10 to 90% Relative Humidity, non-condensing

e. Communications Interface:

1) 1 Mini-B USB Standard 2.0

2) 1 Ethernet Port with RJ-45 Connector

3) RS232C or RS485

f. Program Memory Storage

1) 2GB SD Memory Card

3. Manufacturer/Series: IDEC High Performance Series or Pre-Approved Equal.

D. Monitoring Functions

1. System Dashboard

a. Pressure, flow, and level status.

b. Pump status, including lead pump designation, VFD frequency, torque, kw and current draw.

c. Alarm conditions, with the ability to manually reset alarms.

d. Current values of all system sensors, including pressure and flow.

e. User selectable language icon.

2. Fault Log

The controller shall have a system fault log that displays the precise times of fault occurrences and recoveries, as well as message indicating the fault type. The fault log shall include a fault diagnosis utility that provides possible causes of and solutions to all system faults and warnings.

3. Trend Log

Trend graphing screen capable of detailing pressure, flow, and current data. Graphing function shall give the option to graph and plot a point at user adjustable intervals. All data shall be capable of being downloaded to a USB drive and accessible over Ethernet through FTP server. The trend log shall be .csv format.

4. Advance I/O diagnostics

HMI display must include utility screen that displays the current status of all digital and analog inputs/outputs, including device tag name (i.e., pump #1 auto). This function must be accomplished without opening the control panel.

E. Control Functions

1. Control system must be capable of adding industry standard components without program modifications. Including but not limited to:

a. Fill valve

b. High level float

2. Pressure Settings

   Pressure transmitter calibration, discharge pressure setpoint, and high/low pressure alarm/fault conditions.

3. Flow Settings

   Low and high flow alarm conditions, flow meter sensor calibration settings, and total gallons pumped with user reset button and time/date stamp of last reset. In addition, a non-resettable flow totalizer.

4. Level Settings

   Low- and high-level alarm conditions, level transmitter calibration settings, and level-based pressure setpoint manipulation.

5. Pump Settings

   Pump detail screens showing total run hours of each pump since last reset and any modes, options, or functions specific to that pump. Must include troubleshooting utility as a visual display of pump permissive.

6. Remote Start/Stop Signal Relay

   The PLC shall be able to start and stop the system based on a remote signal 24VAC relay provided in the control panel.

7. Pre-programmed Start-Up Routines
   a. The PLC shall be programmed with various start-up routines that limit and/or delay the starting and acceleration of the pump—ensuring that excessive velocity and pressure do not damage the distribution system.
   b. The program shall include individual routines for initial start-up, mainline fill, re-start after a power outage, and re-start after a system fault.
   c. The operator shall be able to adjust the timing of the routines via the operator interface.

8. Password Protection
   a. Unique user selectable password.

9. Loading and Saving System Default Settings

   The system shall allow the operator to Load Factory Default PLC settings, Save New Operator settings, and Load previously saved Operator PLC settings.

10. The PLC shall allow the operator to change the system date and time.

11. System Protections
    a. Controls shall shut down the pump station in the event of the alarm conditions described in this section, as well as otherwise indicated. The system controls shall attempt to restart the system after alarm shutdown or loss of power. After a user-adjustable number of attempts to re-pressurize the system, the controls shall go into hard shut down and remain so until manually reset.
    b. Low Flow Shutdown. The PLC shall automatically shut down the system if there is no, or too little flow, based on signals received from a flow switch. The low flow shutdown shall have a user adjustable time delay.
    c. Low Level Shutdown. The controller shall automatically shut-down the system based on low level signals from a level transmitter.

d. High Pressure Shutdown. In addition to the pressure data received from the pressure transmitter, the PLC shall automatically shut down the system based on signals from a high-pressure switch.

e. Electrical Fault Shutdowns. Incoming power high, low, and imbalance limits. Shut-down and restart time delays shall be user-adjustable.

f. Analog Transmitter Failure. Input levels of all connected transmitters and meters shall be monitored for failures.

g. Motor starter failure. Circuit breaker and/or motor overload contacts shall be monitored to indicate a motor failure.

F. Communications

1. Web-Based Remote Monitoring and Control

a. The pump station control panel shall include a web-based remote control and monitoring system.

b. Remote Monitoring must be capable of alternating between English and Spanish during operation by an end-user.

c. Remote monitoring and control system shall be non-proprietary and not require a 3rd Party Application.

d. The pump station shall be capable of being remotely monitored from any device with a web browser, such as a PC, tablet, or smart phone.

e. Monitoring of pump station shall be seamless to the user via a web browser that shall be started by simply clicking on a hyperlink. Software shall not be required to be installed or configured on the user's computer.

f. The web page shall include full graphic representation of the pump station and its features and shall be capable of remotely changing all operating parameters of the pump station.

g. The pump station shall automatically send email or text alerts regarding warnings and faults and specify the station and specific fault/alarm.

h. The pump station manufacturer shall supply all required communication hardware except computer and computer accessories, including all necessary direct burial cable and antennas.

i. A cellular modem shall be mounted and wired inside control panel enclosure.

j. The connection shall be capable of communicating to the pump station over cellular modem, high speed Ethernet, or fiber optic cable.

END OF SECTION 333213

SECTION 333217 – HORIZONTAL DRY INSTALLED WASTEWATER PUMP FOR SEWAGE LIFT STATION

PART 1 – GENERAL

1.1 SCOPE:

A. The work in this section shall include furnishing and placing into operation 3 horizontally mounted sewage pump(s) complete with submersible motor, carriage, rails and cable, and local monitoring control panels as specified herein and as indicated on the drawings.

1.2 RELATED WORK:

A. Refer to Division 26 – Electrical for more information regarding pump controls, variable frequency drives, basic electrical requirements and more.

1.3 REFERENCES:

A. American Society for testing and material (ASTM) International

1. A 48: Standard Specification for Gray Iron Castings.

2. A743: Standard Specification Iron-Chromium Nickel, Corrosion Resistant,

B. American National Standards Institute (ANSI):

1. B16.1: Standard for Cast Iron Pipe Flanges and Flanged Fittings, 125 lb.

C. Hydraulic Institute: Current Standards.

1. HI 14.6: Hydrodynamic Pumps for Hydraulic Performance Acceptance Tests.

2. HI 11.6: Submersible Pump Tests

1.4 SUBMITTALS:

A. Submittal data shall be provided to show compliance with these specifications, plans or other specifications that will influence the proper operation of the pump(s).

B. Standard submittal data for approval must consist of:

1. Pump Performance Curves.
2. Pump Outline Drawing.
3. Station Drawing for Accessories.
4. Electrical Motor Data.
5. Typical Installation Guides.
6. Technical Manuals and Parts List.
7. Printed Warranty.
8. Management system certificate ISO 9001.
9. Manufacturer's Equipment Storage Recommendations.

10. Manufacturer's Standard Recommended Start-Up Report Form.

C. Lack of the above requested submittal data is cause for rejection.

1.5 QUALIFICATION REQUIREMENTS

A. The manufacturer shall provide data on alternate equipment manufacturer's experience. Only Manufacturers with 20 or more years of experience who have furnished at least 5 similar lift stations shall be considered.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle products to site under provisions of the Contract Documents

1.7 OPERATIONAL REQUIREMENTS AND WARRANTY

A. The contractor shall supply and install 3 horizontal dry mounted close-coupled submersible wastewater pumps with integral motor cooling system.

B. The impeller shall also be a semi open multi vane self-cleaning impeller designed to transport wastewater with fibrous materials like wet wipes. I shall be wear resistant against sand and grit which is expected to enter the pump station with the sewage or the storm water.

C. The motor of the pump shall be mounted on a service cart to enable the removal of the rotating assembly from volute without disturbing volute or piping and without the need of lifting equipment.

D. Each pump shall be capable to lift 6000 USgpm at a total dynamic head of 20 feet.

E. The NPSHre shall be below 23 feet

F. The hydraulic efficiency in this duty point shall be not less than 71 % and approved according to HI 11.6:2012 Grade 2B.

G. The pumps shall be provided with a prorated 60 months (5 years) warranty against defects in materials and or workmanship. Unless otherwise specified, all other equipment shall be warrantied for 12 months (1 year). The warranty shall be in printed form and previously published as the manufacturer's standard warranty for all similar units manufactured, latest revision. Upon warranty occurrence, the manufacturer's authorized service center shall remove the pump, repair, reinstall and provide start up on the repaired pump. A detailed failure analysis shall be submitted to the Owner for their records summarizing corrective action taken.

H. The manufacturer shall guarantee clog-free operation for a period of 12 months from the date of start-up of the pumps by the local authorized factory representative. A certificate shall be provided to the Owner on the day of start up with the local contact information and effective date. If the impeller clogs with typical solids or modern trash debris normally found in domestic wastewater during this period, an authorized representative shall travel to the jobsite, remove the pump, clear the obstruction and reinstall the pump at no cost for the Owner. A written report shall be provided to the Owner detailing the service call with pictures for verification purposes.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE SEWAGE PUMP(S) FOR HORIZONTAL DRY INSTALLATION (FLYGT NZ 3301 LT 60 HP 81X O.A.E)

A. Each pump shall be equipped with a 60 HP submersible electric motor, capable to operate on a 460 volt, 3 phases, 60 hertz voltage supply.

B. The hydraulic of the pump shall be capable of handling raw domestic wastewater and storm water with fibrous materials like wet wipes.

C. The impeller blades shall be self-cleaning upon each rotation as they pass across a sharp relief groove in the Insert ring and shall keep the impeller blades clear of debris. The clearance between the insert ring and the impeller leading edges shall be adjustable.

D. Due to the presence of sand the impeller shall be made of high chromium cast iron with at least 24% chrome. Impellers that have surface hardening (by thermal, coating, etc.) will not be allowed.

E. The pump shall be capable to operate without any limitation between 50% and 125% of the Best efficiency point (B.E.P) of the performance curve.

	Flow (GPM)	TDH (FT.)	Hydraulic Efficiency %	NPSHre (FT.)
Required Duty Point	6000	20	>71	<23
Guaranteed duty point acc. HI 11.6:2012 Grade 2B	6000	20	>71	<23
Best efficiency point of offered pump (B.E.P.)	5800	20.5	>71.5	<23.5
Flow: B.E.P. at +50 %	8700	7	>42	<27
Flow: B.E.P at – 50 %	2900	30.5	>52	<22

F. The required shaft power (P2) in the guaranteed duty point shall be less than 42 HP. The motor speed shall be max. : 900 rpm. A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output HP and efficiency. This chart shall also include data on starting and no-load characteristics

G. The motor of the pump shall be induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. It shall be submersible according to standard IEC 60034 and protection class IP 68. It shall continue to operate satisfactorily even when the station is subjected to flooding and the motor is permanently submerged by a water column of 65 feet. Motors which can only be submerged for a limited time (IP 67) shall not be considered as equal.

H. The motor shall be provided with an integral motor cooling system. A stainless steel cooling jacket shall encircle the stator housing, providing for dissipation of motor heat regardless of the type of pump installation. An impeller, integral to the cooling system and driven by the pump shaft, shall provide the necessary circulation of the cooling liquid through the jacket. The cooling liquid shall pass about the stator housing in the closed loop

I. The pump shall be capable of operating in a continuous condition in a liquid with a temperature up to 104°F even when the motor is not submerged. Operational restrictions or the demand of auxiliary cooling systems like fans or blowers are not acceptable. It shall be designed to run on an adjustable speed drive (ASD).

J. The stator windings shall be insulated with moisture resistant Class H insulation rated for 356°F.

K. The junction chamber containing the terminal board shall be hermetically sealed from the motor by an elastomeric compression seal. Connection between the cable conductors and stator leads shall be made with threaded compression type binding posts permanently affixed to a terminal board.

L. The motor shall be protected by 3 thermal switches embedded in the stator set to open at 284°F (140°C) and one leakage sensor floating type located in a leakage chamber below the main bearing. The sensor and the switches shall be connected to the control panel which shall stop the motor and send an alarm when the sensors are activated.

M. The motor shall be capable of no less than 30 evenly spaced starts per hour and be able to operate throughout the entire pump performance curve from shut-off through run-out.

N. The discharge flange of the pump shall be 14“ and shall be drilled according ANSI B16.1-89; tab.5. The suction inlet of the pump housing shall be drilled to assemble a suction pipe.

O. The impeller shall be mounted on the motor shaft. Couplings shall not be accepted.

P. The motor shall be provided with an integral motor cooling system. A stainless steel cooling jacket shall encircle the stator housing, providing for dissipation of motor heat regardless of the type of pump installation. An impeller, integral to the cooling system and driven by the pump shaft, shall provide the necessary circulation of the cooling liquid through the jacket. The cooling liquid shall pass about the stator housing in the closed loop system in turbulent flow providing for superior heat transfer. The cooling system shall have one fill port and one drain port integral to the cooling jacket. The pump shall be capable of operating continuously (S1) in an ambient temperature up to 122°F (50 °C) and transport liquids with a temperature up to 104°F (40°C). Operational restrictions at temperatures below 122°F are not acceptable. Fans, blowers or auxiliary cooling systems that are mounted external to the pump motor are not acceptable.

Q. The cable entry shall consist of dual cylindrical elastomer sleeves, flanked by washers, all having a close tolerance fit against the cable and the cable entry. Epoxies, silicones, or other secondary sealing systems shall not be considered acceptable. The shaft shall be sealed by two mechanical seals, each having an independent spring system. The seals shall require neither maintenance nor adjustment and shall be capable of operating in either clockwise or counter clockwise direction of rotation without damage or loss of seal function.

R. Motor and Hydraulic shall be designed and supplied by the pump manufacturer.

S. The shaft shall rotate on two bearings. The motor bearings shall be sealed and permanently grease lubricated with high temperature grease. The upper motor bearing shall be a single row ball bearing to handle radial loads. The lower bearing shall be a double row angular contact ball bearing to handle the thrust and radial forces. Single row lower bearings are not acceptable. The minimum L10 bearing life shall be 50,000 hours at any usable portion of the pump performance field.

T. Each pump shall be provided with a positively driven dual, tandem mechanical shaft seal system consisting of two seal sets, each having an independent spring. The lower primary seal, located between the pump and seal chamber, shall contain one stationary and one positively driven rotat-

ing corrosion and abrasion resistant tungsten-carbide ring. The upper secondary seal, located between the seal chamber and the seal inspection chamber shall be a leakage-free seal. The upper seal shall contain one stationary and one positively driven rotating corrosion and abrasion resistant tungsten-carbide seal ring. The rotating seal ring shall have small back-swept grooves laser inscribed upon its face to act as a pump as it rotates, returning any fluid that should enter the dry motor chamber back into the lubricant chamber. All seal rings shall be individual solid sintered rings. Each seal interface shall be held in place by its own spring system. The seals shall not depend upon direction of rotation for sealing. Mounting of the lower seal on the impeller hub is not acceptable. Shaft seals without positively driven rotating members or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces are not acceptable. The seal springs shall be isolated from the pumped media to prevent materials from packing around them, limiting their performance.

U. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. Seal lubricant shall be non-hazardous.

V. Where a seal cavity is present in the seal chamber, the area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.

W. The Materials of construction shall be as follows:
1. Pump housing: ASTM A-48, Class 35B
2. Cooling jacket: Stainless steel AISI 316
3. Impeller and insert ring: A 532 ALLOY III A (25% chrome)
4. Stator housing: ASTM A-48, Class 35B
5. Shaft: ASTM A479 S43100-T.
6. Shaft seal: Pump side: - Corrosion resistant Tungsten carbide WCCR
7. Shaft seal Motor side: - Corrosion resistant Tungsten carbide WCCR

X. All castings must be blasted before coating. All wet surfaces are to be coated with two-pack oxyrane ester Duasolid 50. The total layer thickness should be at least 120 microns. Zink dust primer shall not be used.

Y. The motor shall be equipped with 30 feet of screened cable suitable for submersible pump applications. The power cable shall be sized according to NEC and ICEA standards. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.

2.2 QUALITY ASSURANCE

A. Each completed and assembled pump/motor unit shall undergo the following factory tests at the manufacturer’s plant prior to shipment. The Manufacturer shall provide on demand a copy of his quality control plan for these tests and an ISO 9001 factory certificate.

1. Minimum 3-point hydraulic performance test according HI 11.6:2012 Grade 2B

2. No-Leak seal integrity test
3. Electrical integrity test

2.3 SUPPORT STAND AND SERVICE CART FOR PUMP(S)

A. Each Pump shall have an integral 316 stainless steel suction service inlet for ease of inspection and visual verification of impeller clearance using a feeler gage. The use of spool pieces, clamping type fittings, TEEs, or other devices which require removal of fittings, hoists, cranes and/or lifting devices, or that potentially impart negative hydraulic impact to the pump inlet per HI standards shall not be considered acceptable. All service inlet devices shall be hydrostatically tested and integrally mounted to the pump volute for the pump working pressure. Pumps that rely on externally adjusted wear plates risk non-uniform adjustment, bearing damage, and which do not facilitate visual impeller inspection will not be acceptable. The use of pipe expansion joints to facilitate impeller gap adjustment shall not be acceptable. A ¼"" pressure gauge connection shall be included standard on the suction service inlet.

B. The suction flange shall be 16" and drilled according ANSI B16.1-89; tab.5.

C. Each motor shall be assembled on a 316 stainless steel service cart with rollers and 2 rails. The cart shall provide a rigid support and enable the removal of the rotating assembly from volute without disturbing volute or piping and without the need for hoists or lifting apparatus during impeller maintenance. The service cart and the rails to pull out motor with the impeller to enable wear ring, impeller, and lower seal replacement without the need for hoists, cables, or pulley systems, A lifting cradle shall be provided to enable safe and easy removal of pump and motor from the station for major repairs without the need for lifting slings. This service shall not request more than 1 person

D. It shall be possible to rotate the pump housing in steps of 45° to connect the discharge flange to the discharge pipe without the demand of additional elbows.

2.4 SUBMERSIBLE CABLE CONNECTION BOX ACC. NEMA 6P

A. The submersible cable of the pump shall be connected to the cable from the Control panel in a floor or wall mounted cable connection box to ease the installation and disassembling of the pumps and keep the submersible cables as short as possible.

B. The cable connection box shall be submersible NEMA 6P (IP 68) to secure that no water can enter the motor via the cables even when the complete area is flooded.

2.5 MONITORING & STATUS (FLYGT MAS 801 OR EQUIVALENT)

A. The pump manufacturer shall supply a Control system deigned to monitor and control his pumps. The Monitoring system shall be mounted in the cabinet and contain per pump 1 Base unit acting as a gateway between the Pump and the Central Monitoring and a Central Control Unit (CU) for processing data to SCADA system supplied by the contractor

B. Each pump shall be connected by just 2 controls leads to the base unit (BU). The control leads shall be part of the Motor cable. An additional Pilot cable shall not be allowed.

C. The Base Unit (BU) shall be able to stop the pump if required via an interlocking relay and it shall provide connections for optional measuring modules such as a power meter (such as Flygt PAN 312) and other I/O modules.

D. The central unit (CU) shall be provided for external access and information exchange with the monitoring system via one single point. The user should be able to connect to the CU via an RJ45 jack to Local PC point to point and Local area network.

E. A local operator panel shall be possible to connect to the CU via a separate RJ45 socket.

F. The CU shall have a functionality based on embedded web pages that can be used through a PC or operator panel that allows: The CU shall have a functionality based on embedded web pages that can be used through a PC or operator panel that allows:

1. A graphical user interface for configuration and analysis via computer and HMI
2. Pump status overview
3. Alarm management
4. Analysis through trend graphs and histograms.
5. External communication with any SCADA via Modbus RTU or Modbus TCP

G. The CU shall contain the same pump data and logged data stored in each pump electronic module for quick access and redundancy.

H. The system shall support the service and maintenance policy that applies to the pump by generating service reminders and graphically providing users with an overview of service status that facilitates planning of upcoming service

I. The Cabinet shall be equipped with HMI Touch panel for access and interaction with the Monitoring and Control system. The panel should be at least 15 inches in size and able to show color.

J. When a pump related alarm is generated, the system shall support the user in the form of:

1. Measurement data linked to the specific alarm item for analysis.
2. Text information about possible root cause errors.
3. Remedial actions

K. Power analyser to monitor electrical supply quantities and transfer following data via RS-485/Modbus:

1. System pump/motor current

2. Individual phase pump/motor current (each of 3-phases)

3. Current and Voltage imbalance

4. System voltage

5. Individual line voltage (each of 3-lines)

6. System power and Power factor

7. Energy consumption

L. The motor shall be protected by the following sensors

1. 3 bi-metal thermal switches for thermal control of the stator

2. PT 100 thermal sensor (RTD) to monitor the stator temperature of 1 winding

3. PT 100 thermal sensor (RTD) to monitor the temperature of the main bearing

4. Vibration sensor to monitor vibration on 3 axes from 10 – 600 Hz.

5. Float switch in leakage chamber to monitor leakage in the leakage chamber.

6. Float switch in the terminal connection housing to monitor any leakage through the cables and the cable entries.

M. The pump shall be supplied with a Pump electronic module (PEM) mounted inside the motor. The PEM shall collect, store and digitize all measurement data from all sensors and shall communicate the data in a digital format via 2 control leads integral to the pump power cable to a Base Unit mounted in a pump control cabinet to the Central control unit. An additional pilot cable shall not be allowed.

N. The PEM shall have information about the pump as well as features for startup and service support, such as:

1. Pump serial number and other data plate information.

2. Specific configuration of monitoring functions for the actual pump such as alarm limits, delays, reset types, etc.

3. Counters by which the system can generate service reminders in accordance with the service policy specified in the pump manual.

4. Operating data and alarm history to analyse the condition of the pump and enable troubleshooting and reporting.

5. Accumulated running time and number of starts.

6. Pump duty rate (percentage of operation).

PART 3 – EXECUTION

3.1 GENERAL:

A. Perform installation in accordance with Contract Documents and manufacturers specifications.

3.2 EXAMINATION:

A. A factory trained technician shall examine the work area prior to beginning work and check the following:

1. The environment is safe to begin working in
2. All surfaces are ready to receive work
3. All tools are in the proper location and are in good condition
4. Grounding of the system

3.3 FIELD QUALITY CONTROL

A. The follow field tests shall be performed by a factory trained technician

1. Point to point wiring verification
2. Utility power verification
3. Site acceptance testing
4. System demonstration

B. Point to Point I/O Verification

1. After installation of the pumps and the control panel, a factory trained technician shall prepare the I/O checklist. The checklist shall include the following:
   a. All inputs and outputs connected to the control panel
   b. All alarms that can be generated by the control panel

2. The technician shall follow a test procedure to test all I/O and alarms.
   a. All digital inputs shall be tested from point of origin unless it is unsafe.
   b. All digital outputs shall be tested by running a simulation test from the controller or by simulating the fault condition.
   c. All analog inputs shall be tested from the point of origin where possible and by use of a signal generator otherwise.
   d. All analog outputs shall be tested by running a simulation program or by forcing the output to a value.

3. Configuration Verification
   a. The factory trained technician shall document the settings using a factory provided configuration checklist. Each parameter shall be verified prior to the beginning of testing and then again after testing is completed.
   b. The configuration of the pump station manager as well as the IPS gateways shall be documented.
   c. The pump station manager configuration shall be saved to a factory provided SD card after testing is completed.

3.4 STARTUP SERVICE:

A. After installation, a pump station start-up shall be performed by the installing contractor under the supervision of the manufacture's authorized representative. 8 hours of field service shall be provided by an authorized, factory trained representative of the pump manufacturer. Services

shall include, but not be limited to, inspection of the completed pump station installation to ensure that it has been performed in accordance with the manufacturer's instructions and recommendations, supervision of all field-testing and activation of the Pump Manufacturer's Warranty. The test shall demonstrate to the satisfaction of the Owner that the equipment meets all specified performance criteria, is properly installed and anchored, and operates smoothly without exceeding the full load amperage rating of the motor. The Contractor shall be responsible for coordinating the required field services with the Pump Manufacturer.

B. Engage a factory-authorized service representative to perform startup service.

C. Complete installation and startup checks according to manufacturer's written instructions.

D. Start pumps without exceeding safe motor power:
   1. Start motors.
   2. Check general mechanical operation of pumps and motors.
   3. Test and adjust controls and safeties on both local and at the MCP for proper operation.
   4. Remove and replace damaged and malfunctioning components.
   5. Pump Controls: Set pump controls for automatic start, stop, and alarm operation as required for system application.
   6. Set field-adjustable switches and circuit-breaker trip ranges as indicated, or if not indicated, for normal operation.

3.5 CERTIFICATION OF TESTING

A. All tests shall be performed in the presence of a duly authorized representative of the Owner. If the presence is waived, certified results shall be provided by the Contractor.

B. Written notice of all tests shall be given two weeks in advance.

C. All test equipment shall be provided by the Contractor.

3.6 DEMONSTRATION AND TRAINING:

A. Training shall be a minimum of four (4) hours and cover the complete Pumping System and related controls.

B. Instruction material shall be provided for four (4) trainees.

3.7 ANNUAL PREVENTATIVE MAINTENANCE AGREEMENT

A. Training In addition to the pump(s) the supplier shall provide a minimum one-year preventative maintenance agreement that includes a minimum of one annual site visit with a multi-point pump(s) inspection performed by manufacturer certified and manufacturer trained technician(s) within 12 months of installation.

B. The multi-point inspection shall include visual and functional inspections of all wet well components, pumps and control panels; oil inspection and oil change of submersible pumps; pertinent physical and electrical data to reasonably expect prolonged equipment operation for a year of additional service.

C. The end-user shall also be provided a copy of a summarized report at the conclusion of the multi-point inspection.

END OF SECTION 333217

SECTION 333913.01 - PRECAST CONCRETE MANHOLES (SANITARY SEWAGE)

PART 1 - GENERAL

1.1 SUMMARY:

A. Furnish and install precast concrete manholes at the locations and elevations shown on the Plans.

1.2 EXISTING CONDITIONS:

A. It shall be the Contractor's responsibility to investigate all site conditions that may affect his work.

PART 2 – MATERIALS

2.1 GENERAL:

A. All manholes shall be of precast concrete, consisting of precast reinforced concrete sections, a conical or flat slab top section and base (footing) section.

B. Precast manhole sections shall be manufactured in accordance with ASTM Designation C478 (latest revision).

C. The minimum compressive strength of the concrete sections shall be 4000 psi

D. Manholes shall conform to the typical details shown on the Plans.

2.2 CONCRETE (GENERAL):

A. All the reinforced concrete shall consist of Portland cement, mineral aggregates and water at proper ratios with steel reinforcement.

B. Cement shall be air-entraining Portland Cement per specification for air entraining Portland Cement (ASTM Designation C 175).

C. All aggregates shall conform with, except the gradation requirements, the Specification for Concrete aggregates (ASTM Designation C 33).

D. All Concrete shall be thoroughly mixed by a mechanical batch mixer. The proportion of aggregate, cement and water shall be such as to acquire the proper strength and quality of concrete required (4000 psi).

2.3 CONCRETE (REINFORCEMENT):

A. The circumferential reinforcement in the eccentric cone, riser sections, and base walls shall be 0.12 square inches per lineal foot.

B. The reinforcement for the top slab shall be 1/2" diameter reinforcing bars on 6" centers, both ways, placed in the lower half of the slab.

C. The reinforcement for the base section (footing) shall be a minimum of 0.12 sq. inches per lineal foot, both ways, placed in the top and bottom of the base.

D. All circular reinforcement shall be placed approximately at the center of the wall.

2.4 PHYSICAL DIMENSIONS/TYPES:

A. All manholes shall have a minimum diameter of four foot (4') unless otherwise indicated. All top openings shall be a minimum of 24" diameter.

B. Four Foot (4') Diameter Manholes:

1. All manhole components shall have 48" inside diameters with interlocking bell and spigot type joints.
2. The eccentric cone with a 24" diameter top opening shall have an internal bottom diameter of 48" with a 5" minimum wall thickness. The wall thickness at the top shall be 8".
3. The eccentric cone with a 30" diameter top opening shall have an internal bottom diameter of 48" with a 5" minimum wall thickness. The wall thickness at the top shall be 7".
4. The flat slab top shall have a minimum thickness of 8".
5. The riser sections shall have a minimum wall thickness of 5".
6. The base section (footing) shall be 4' 10" in diameter and 6" thick. The base and first riser section shall be cast integrally.

C. Five Foot (5') Diameter Manholes:

1. All manhole components shall have 60" inside diameters with interlocking bell and spigot type joints.
2. The eccentric cone with a 24" diameter top opening shall have an internal bottom diameter of 60" with a 6" minimum wall thickness. The wall thickness at the top shall be 8".
3. The eccentric cone shall have a 48" diameter top opening and have an internal bottom diameter of 60" with a 6" minimum wall thickness. The wall thickness at the top shall be 6". The minimum height from the invert elevation to the bottom of the eccentric cone shall be 7'-0", if this dimension cannot be obtained, then a flat slab top must be used.
4. The flat slab top shall have a minimum thickness of 8".
5. The riser sections shall have a minimum wall thickness of 6".
6. The base section (footing) shall be 6' in diameter and 8" thick. The base and first riser section shall be cast integrally.

D. Drop Manholes:

1. Shall consist of base and riser sections containing the drop assembly, standard riser sections and conical or flat slab top sections.
2. Shall comply to all other dimensional data noted hereinabove, for the diameter drop manhole shown or called for.
3. The barrel sections of all drop inlet components must be free and clear of all cavities.
4. The cores must line up perfectly without any possible ridges.
5. The space between sections must be kept to the minimum.
6. The center line of the drop inlet sections must be parallel to the main manhole section so that all seals can seat properly.
7. All drop inlet sections must be poured monolithically with the main manhole sections so that all seals can seat properly.
8. The reinforcement around the drop inlet cores must be tied into the main manhole sections.

2.5 JOINTS:

A. All tongue and groove joints shall be formed in such a manner so that a rubber seal can be applied.

B. All rubber joints must be a rubber conforming to the requirements established by ASTM Designation 443-60T. The rubber gasket must be formed with two curved fins.

C. All rubber gaskets must be installed per manufacturer's instructions pertaining to the location of the gasket, lubrication, and setting of the manhole sections.

2.6 MANHOLE STEPS:

A. Steps shall be made of Aluminum Alloy #6061-T6 with the drop step design as manufactured by the Aluminum Company of America. As an alternate copolymer polypropylene plastic steel reinforced manhole steps as manufactured by M.A. Industries, Inc., Model PS2-PF (or acceptable equal) may be utilized with the acceptance of the Engineer.

B. Steps shall be installed in both the eccentric cone and riser sections. In the conical section, the steps must be mortared or poured in the vertical wall. All steps must be aligned in each section so as to form a continuous ladder with the steps equally spaced at 12" increments.

2.7 RESILIENT SEALS:

A. Resilient seals of the "compression flange" type shall be furnished and installed in all pipe openings in manholes. Grouting of pipe connections will not be permitted except as specifically accepted by the Engineer.

B. A "rubber boot" shall be cast integrally into each manhole cone or flat slab top. The "boot" shall be water-lok manhole entry sleeve as manufactured by A-Lok Products, or acceptable equal.

2.8 LIFT HOLES:

A. Each section of the precast manhole shall have not more than two holes for the purpose of handling and laying. These holes shall be tapered and shall be plugged with rubber stoppers or mortar after installation.

2.9 MANHOLE FRAMES AND COVERS:

A. Shall be made of tough, close-grained gray-iron, without the admixture of any cinder, iron or metal of inferior quality.

B. Iron shall be capable of developing a tensile strength of 18,000 psi and shall be able to stand chipping and drilling by hand.

C. Shall be made from properly prepared patterns and be sound, true, smooth and free from blisters, sand holes, scales or any other defects.

D. No plugging or other stopping of holes will be permitted.

E. Manholes shall be fitted with cast iron frames and covers with two "lifting" holes only. Manhole frame and cover shall have continuous and even bearing on the frame. Covers which rock on their frames will not be accepted; and the Contractor shall, if necessary, machine or grind cover in place to obtain an even bearing. Covers shall fit in frame without binding along the perimeter. Frames shall have continuous and even bearing on the manhole.

F. Manhole frames and covers shall have a minimum weight of 400 pounds.

G. Frames and covers shall be of the type as called for on the Plans.

H. All covers shall be suitably marked with the words "Sanitary Sewer", "Storm Sewer" or appropriate marking as accepted by the Engineer.

I. Unless otherwise indicated on the plans or otherwise waived by the Owner, the cover shall bear the name of the Owner and the year of the project completion.

2.10 INVERTS:

A. Precast base sections may be supplied by the manufacturer with inverts precast, or the inverts may be cast in the field by the Contractor.

B. Inverts shall be smooth and accurately shaped to a semi-circular bottom conforming to the inside of the adjacent sewer sections.

C. Changes in direction of the sewer and entering branches shall have a circular curve of as large a radius as the manhole will permit.

D. If sewer pipes are of different diameter, the channels shall taper uniformly from one size to the other.

E. Concrete used in the formation of inverts shall have a minimum compressive strength of 2500 psi.

PART 3 - CONSTRUCTION DETAILS

3.1 GENERAL:

A. Installation of manholes shall meet the requirements as shown on the Plans.

B. Manholes shall be set at the elevations and locations as shown on the Plans.

C. Precast base sections shall be installed on a firm stabilized foundation prepared similar to that required for the proper installation of the adjacent pipeline, as described elsewhere in the contract specifications.

D. Inverts cast in the field shall comply in all respects to the requirements of Paragraph 2.10 hereinabove.

3.2 GRADE ADJUSTMENT:

A. Grade adjustment rings shall be installed where required in accordance with the detail shown on the contract plans.

B. Such rings shall be formed of solid concrete brick masonry set in mortar; precast concrete rings set in mortar; or cast in place concrete; all joints shall be completely filled and water tight.

C. The grade adjustment using mortar, bricks, etc. from top of the flat slab top or eccentric cone, to bottom of the manhole casting frame shall be less than or equal to 11".

3.3 MARKING:

A. Each eccentric cone, flat slab top, riser section, and base section shall be plainly marked to indicate the date of manufacture and the name or trademark of the manufacturer.

3.4 REPAIRS:

A. Manholes may be repaired, if necessary, because of occasional minor imperfections in the manufacture or incidental injury during handling, if in the opinion of the Engineer such repairs are not detrimental to the utilization of the manhole as specified herein, the Engineer, by allowing such repairs, is not modifying or waiving the manhole testing requirements.

3.5 TESTING:

A. Time for testing -

1. In general, manholes shall be tested prior to placement of paving materials. Paving prior to testing and acceptance of the manholes shall be at the Contractor's risk.
2. Testing shall be performed at as late a date as possible, after the work has been completed and time for settlement has occurred.
3. In no instance shall manholes be tested prior to completion of construction work in the area, nor prior to two (2) weeks after installation of the manholes.
4. All manholes shall be tested unless the testing requirement is waived by both the Owner and Engineer.

B. Procedures for testing -

1. In order to keep leakage and infiltration in sewers to a minimum, it is necessary that special attention be given to the specification requirements covering workmanship, materials and testing. The specification for this installation includes the following provisions:

   a. Manholes shall be tested separately and independently with the allowance of 0.1 gal/(ft of diameter)(ft of head) per hour.
   b. In testing for infiltration, sufficient weir measurements shall be made in manholes to furnish the necessary information.

   c. The minimum time of the test is to be twenty (20) hours.
   d. Both an exfiltration and infiltration test shall be performed on every manhole and conform to ASTM C969 (year of latest revision).

2. Where acceptable to the Engineer and all applicable reviewing authorities, the Contractor shall have the option of performing manhole vacuum testing under the following revisions:

   a. Initial test pressure minus (-) 10" Hg.
   b. Test time for the vacuum to drop to minus (-) 9" Hg shall equal or exceed ninety (90) seconds for four (4) foot diameter manholes and one hundred five (105) seconds for five (5) foot diameter manholes.
   c. Other testing requirements (General) -

      1) All testing shall be performed with a representative of the Engineer and/or Owner present.
      2) The Contractor shall give ample notification of his intended test date such that observation scheduling can be made. Any delays and associated costs caused by the Contractor's failure to schedule the attendance of necessary representatives shall be borne by the Contractor.
      3) The location of the manholes to be tested, duration of test, and other requirements shall be acceptable to the Engineer.
      4) All evident leaks shall be investigated and the necessary repairs made, and leakage minimized regardless of total leakage as shown by test.
      5) Manholes which fail to meet tests shall be repaired and retested as necessary until compliance with test requirements. Defective manholes

and connections shall be removed and replaced.

6) All materials and equipment, cooperation and assistance necessary to perform the tests specified herein to the satisfaction of the Engineer or his duly authorized agent shall be borne by the Contractor.

PART 4 - MEASUREMENT AND PAYMENT

4.1 The unit of measurement will be for each manhole, properly installed, of the type specified on the Plans and in the Proposal.

4.2 Payment will be made for each manhole at the unit price bid under the appropriate item in the bid and shall include all excavation, backfill, crushed stone foundation, concrete foundations and benches, all adjustment rings laid in Portland seals, frames and covers, testing and all work necessary for a completed structure.

4.3 Where no separate payment item is provided for this work, the complete manhole work shall be deemed included in the other items of the Proposal, with no additional or separate payment to be made for manholes installed.

END OF SECTION 333913.01

SECTION 334100 – HIGH DENSITY POLYETHYLENE DRAINAGE PIPE
(Double-Wall Corrugated)

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Furnish and install corrugated double-wall high density polyethylene drainage pipe of the size(s) shown on the Plans and in the Proposal.

1.2 RELATED WORK:

A. Backfill (Crushed Stone Foundation) - Section 312323.13.01

B. Trenching, Backfilling and Compaction Work - Section 312333

1.3 EXISTING CONDITIONS:

A. It shall be the Contractor's responsibility to investigate all site conditions that may affect his work.

PART 2 - MATERIALS

2.1 GENERAL:

A. All drainage pipe to be installed shall be Type N-12 as manufactured by Advanced Drainage Systems, Inc. (ADS), or acceptable equal per AASHTO.

B. Pipe Requirements
   1. 4 through 10-inch (100 to 250mm) pipe shall meet AASHTO M252, Type S
   2. 12 through 60-inch (300 to 1500 mm) pipe shall meet AASHTO M294, Type S or ASTM F2306
   3. Manning’s “n” value for use in design shall be 0.012

C. Fitting Requirements
   1. Fittings shall conform to AASHTO M252, AASHTO M294, or ASTM F2306. Bell and spigot connections shall utilize a welded bell and valley or saddle gasket meeting the watertight join performance requirements of AASHTO M252, AASHTO M294, or ASTM F2306.

D. Material Properties
   1. Material of pipe and fitting production shall be high-density polyethylene conforming with the minimum requirements of cell classification 424420C for 4 through 10-inch (100 to 250 mm) diameters, and 435400C for 12 through 60-inch (300 to 1500 mm) diameters, as defined and described in the latest version of ASTM D3350. Except that carbon black

content should not exceed 4%. The 12 through 60-inch pipe material shall comply with the notched constant ligament-stress (NCLS) test as specified in Sections 5.1 and 9.5 of AASHTO M294 and ASTM F2306 respectively.

PART 3 - CONSTRUCTION DETAILS

3.1 GENERAL:

A. All pipe shall be handled and assembled in accordance with the manufacturer's instructions, except as modified herein or on the Plans.

B. Piping shall be set at the elevations and locations as shown on the Plans.

C. Installation shall conform to the requirements of the details as shown on the Plans.

D. Installation shall be in accordance with ASTM D2321 and ADS recommended installation guidelines, with the exception that minimum cover in trafficked areas for 4 through 48 inch (100 to 1200 mm) diameters shall be one foot and for 60-inch diameter the minimum cover shall be 2 feet in single run applications.

3.2 JOINTS:

A. Pipe shall be joined using a bell and spigot join meeting the requirements of AASHTO M252, AASHTO M294, or ASTM F2306.

B. The joint shall be watertight according to the requirement of ASTM D3213.

C. Gaskets shall meet the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris.

D. A joint lubricant available from the manufacturer shall be sued on the gasket and bell during assembly. 12 through 60-inch diameter shall have an exterior bell wrap installed by the manufacturer.

3.3 FIELD PIPE AND JOINT PERFORMANCE:

A. To assure watertightness, filed performance verification may be accomplished by testing in accordance with ASTM F2487. Appropriate safety precautions must be used when field-testing any pipe material. Contact the manufacturer for recommended leakage rates.

3.4 DAMAGES TO MATERIALS:

A. Movement of construction equipment and all other vehicles and loads over and adjacent to any pipe shall be done at the Contractor's risk. Any pipe, which in the judgement of the Engineer is damaged or disturbed through any cause, shall be replaced at the expense of the Contractor and at no cost to

the Owner.

B. Any pipe or materials designated by the Engineer as defective or damaged shall be immediately removed from the project site and replaced with acceptable materials. Such replacement shall be made at no cost to the Owner.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT:

A. Measurement will be made based on the total linear foot of pipe, type and size placed, as measured by the Engineer. Measurements shall be made horizontally along the axis of the pipe and shall include the run through all fittings and/or manholes and catch basins.

4.2 PAYMENT:

A. Payment will be made at the unit price bid under the appropriate item(s) of the Proposal; the price bid shall include excavation, removal of any existing piping shown to be removed, pipe and fittings, end sections, crushed stone foundation (as required by the details), backfill in a manner acceptable to the Engineer, restoration, including all labor, materials, equipment and appurtenances as required to complete the work.

END OF SECTION 334100

SECTION 334413.13 - PRECAST CONCRETE CATCH BASINS

PART 1 – GENERAL

1.1 WORK INCLUDED:

A. Furnish and install precast concrete catch basins at the locations and elevations shown on the Plans.

1.2 RELATED WORK:

A. Trenching, Backfilling and Compaction Work - Section 312333

1.3 EXISTING CONDITIONS:

A. It shall be the Contractor's responsibility to investigate all site conditions that may affect his work.

PART 2 - MATERIALS

2.1 GENERAL:

A. All catch basins shall be precast concrete, manufactured in accordance with ASTM Designation C478 (latest revision).

B. The minimum compressive strength of concrete for all sections shall be 4000 psi.

C. Catch basins shall conform to the typical details shown on the Plans.

2.2 CONCRETE (GENERAL):

A. All reinforced concrete shall consist of Portland Cement, mineral aggregates and water at the proper ratios with steel reinforcement.

B. The cement shall be air-entrained Portland Cement per ASTM Designation C175.

C. All aggregates shall conform with, with the exception of gradation requirements, the specifications for concrete aggregate, ASTM C33.

D. All concrete shall be thoroughly mixed by mechanical batch mixer. The proportions of aggregate, cement and water shall be such as to acquire the proper strength and quality of concrete required (4000 psi).

2.3 CONCRETE (REINFORCEMENT):

A. Bar reinforcement shall consist of deformed bars which conform to the requirements of ASTM A615, Grade 40. Stirrups may be structural grade.

B. Bars shall be rolled from billets directly reduced from ingots of properly identified heats of open hearth or electric furnace steel, and shall be protected from moisture by being stored in warehouses or other acceptable places prior to use.

2.4 FRAMES, GRATES AND COVERS:

A. Shall be made of tough, close-grained gray-iron, without the admixture of any cinder, iron or metal of inferior quality.

B. Iron shall be capable of developing a tensile strength of 18,000 psi and shall be able to stand chipping and drilling by hand.

C. Shall be made from properly prepared patterns and be sound, true, smooth and free from blisters, sand holes, scales or any other defects.

D. No plugging or other stopping of holes will be permitted.

E. Frames, grates and covers shall be of the type as called for on the Plans.

PART 3 - CONSTRUCTION DETAILS

3.1 GENERAL:

A. Installation of catch basins shall meet the requirements as shown on the Plans.

B. All catch basins shall be set at the elevations and locations as shown on the Plans.

3.2 GRADE ADJUSTMENT:

A. Adjustment to grade for all frames and covers shall be made by means of solid concrete bricks laid in mortar.

B. All joints shall be completely filled and watertight.

C. In no instance shall the grate adjustment be more than twelve (12) inches.

3.3 PIPE ENTRANCES:

A. All pipe entrances at catch basins shall be sealed with mortar completely filling the annular space and watertight.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT:

A. The unit of measurement will be for each catch basin properly installed of the type specified on the Plans and in the Proposal.

4.2 PAYMENT:

A. Payment will be made for the number of catch basins of each type and shall include all excavation, foundations, frames, grates, and covers, adjusting masonry and all work necessary for a completed structure.

END OF SECTION 334413.13

SECTION 334913 - PRECAST CONCRETE MANHOLES (STORM DRAINAGE)

PART 1 – GENERAL

1.1 WORK INCLUDED:

A. Furnish and install precast concrete manholes at the locations and elevations shown on the Plans.

1.2 EXISTING CONDITIONS:

A. It shall be the Contractor's responsibility to investigate all site conditions that may affect his work.

PART 2 - MATERIALS

2.1 GENERAL:

A. All manholes shall be of precast concrete, consisting of precast reinforced concrete sections, all manholes shall be conical, less specifically call out as, a conical flat slab top section and base (footing) section.

B. Precast manhole sections shall be manufactured in accordance with ASTM Designation C478 (latest revision).

C. The minimum compressive strength of the concrete sections shall be 4000 psi.

D. Manholes shall conform to the typical details shown on the Plans.

2.2 CONCRETE (GENERAL):

A. All the reinforced concrete shall consist of Portland cement, mineral aggregates and water at proper ratios with steel reinforcement.

B. Cement shall be air-entraining Portland cement per specification for air-entraining Portland Cement (ASTM Designation C 175).

C. All aggregates shall conform with, with the exception of the gradation requirements, the Specification for Concrete Aggregates (ASTM Designation C 33).

D. All Concrete shall be thoroughly mixed by a mechanical batch mixer. The proportion of aggregate, cement and water shall be such as to acquire the proper strength and quality of concrete required (4000 psi).

2.3 CONCRETE (REINFORCEMENT):

A. The circumferential reinforcement in the eccentric cone, riser sections, and base walls shall be 0.12 square inches per lineal foot.

B. The reinforcement for the top slab shall be 1/2" diameter reinforcing bars on 6" centers, both ways, placed in the lower half of the slab.

C. The reinforcement for the base section (footing) shall be a minimum of 0.12 sq. inches per lineal foot, both ways, placed in the top and bottom of the base.

D. All circular reinforcement shall be placed approximately at the center of the wall.

2.4 PHYSICAL DIMENSIONS/TYPES:

A. Four Foot (4') Diameter Manholes:

1. All manhole components shall have 48" inside diameters with interlocking bell and spigot type joints.
2. The eccentric cone with a 24" diameter top opening shall have an internal bottom diameter of 48" with a 5" minimum wall thickness. The wall thickness at the top shall be 8".
3. The eccentric cone with a 30" diameter top opening shall have an internal bottom diameter of 48" with a 5" minimum wall thickness. The wall thickness at the top shall be 7".
4. The flat slab top shall have a minimum thickness of 8".
5. The riser sections shall have a minimum wall thickness of 5".
6. The base section (footing) shall be 4' 10" in diameter and 6" thick. The base and first riser section shall be cast integrally.

B. Six Foot (6') Diameter Manholes:

1. All manhole components shall have 72" inside diameters with interlocking bell and spigot type joints.
2. The eccentric cone with a 24" diameter top opening shall have an internal bottom diameter of 60" with a 6" minimum wall thickness. The wall thickness at the top shall be 8".
3. The eccentric cone shall have a 60" diameter top opening and have an internal bottom diameter of 72" with a 6" minimum wall thickness. The wall thickness at the bottom shall be 6".
4. The flat slab top shall have a minimum thickness of 6".
5. The riser sections shall have a minimum wall thickness of 6".
6. The base section (footing) shall be 6' in diameter and 8" thick. The base and first riser section shall be cast integrally.

2.5 JOINTS:

A. All tongue and groove joints shall be formed in such a manner so that a rubber seal can be applied.

B. All rubber joints must be a rubber conforming to the requirements established by ASTM Designation 443-60T. The rubber gasket must be formed with two curved fins.

C. All rubber gaskets must be installed per manufacturer's instructions pertaining to the location of the

gasket, lubrication, and setting of the manhole sections.

2.6 MANHOLE STEPS:

A. Steps shall be made of Aluminum Alloy #6061-T6 with the drop step design as manufactured by the Aluminum Company of America, Step #12653-B WACO F-14-5-111, or acceptable equal.

B. Steps shall be installed in both the eccentric cone and riser sections. In the conical section, the steps must be mortared or poured in the vertical wall. All steps must be aligned in each section so as to form a continuous ladder with the steps equally spaced at 12" increments.

2.7 RESILIENT SEALS:

A. Resilient seals of the "compression flange" type shall be furnished and installed in all pipe openings in manholes. Grouting of pipe connections will not be permitted except as specifically accepted by the Engineer.

2.8 LIFT HOLES:

A. Each section of the precast manhole shall have not more than two holes for the purpose of handling and laying. These holes shall be tapered and shall be plugged with rubber stoppers or mortar after installation.

2.9 MANHOLE FRAMES AND COVERS:

A. Shall be made of tough, close-grained gray-iron, without the admixture of any cinder, iron or metal of inferior quality.

B. Iron shall be capable of developing a tensile strength of 18,000 psi and shall be able to stand chipping and drilling by hand.

C. Shall be made from properly prepared patterns and be sound, true, smooth and free from blisters, sand holes, scales or any other defects.

D. No plugging or other stopping of holes will be permitted.

E. All castings, wherever called for on the plans, shall be painted thoroughly with at least two good coats of asphaltum or any other coating as required for acceptance by the Engineer.

F. Manholes shall be fitted with cast iron frames and covers with two "lifting" holes only. Manhole frame and cover shall have continuous and even bearing on the frame. Covers which rock on their frames will not be accepted; and the contractor shall, if necessary, machine or grind cover in place to obtain an even bearing. Covers shall fit in frame without binding along the perimeter.

G. Manhole frames and covers shall have a minimum weight of 400 pounds.

H. Frames and covers shall be of the type as called for on the Plans.

I. All covers shall be suitably marked with the words "DRAINAGE", "STORMWATER" or other appropriate marking as accepted by the Engineer.

J. When indicated on the Plans, the cover shall bear the name of the Owner and the year of project completion.

PART 3 - CONSTRUCTION DETAILS

3.1 GENERAL:

A. Installation of manholes shall meet the requirements as shown on the Plans.

B. Manholes shall be set at the elevations and locations as shown on the Plans.

C. Precast base sections shall be installed on a firm stabilized foundation prepared similar to that required for the proper installation of the adjacent pipeline or other improvement, as described elsewhere in the contract specifications.

3.2 GRADE ADJUSTMENT:

A. Grade adjustment rings shall be installed where required in accordance with the detail shown on the contract plans.

B. Such rings shall be formed of solid concrete brick masonry set in mortar; precast concrete rings set in mortar; or cast in place concrete; all joints shall be completely filled and water tight.

3.3 MARKING:

A. Each eccentric cone, flat slab top, riser section, and base section shall be plainly marked to indicate the date of manufacture and the name or trademark of the manufacturer.

3.4 REPAIRS:

A. Manholes may be repaired, if necessary, because of occasional minor imperfections in the manufacture or incidental injury during handling, if in the opinion of the Engineer such repairs are not detrimental to the utilization of the manhole as specified herein.

PART 4 - MEASUREMENT AND PAYMENT

4.1 MEASUREMENT:

A. The unit of measurement will be for each manhole, properly installed, of the type specified on the Plans and in the Proposal.

4.2 PAYMENT:

A. Payment will be made for each manhole at the unit price bid under the appropriate item in the bid and shall include all excavation, backfill, crushed stone foundation, concrete foundations and benches, all adjustment rings laid in Portland Cement, steps, all furnishings and setting of ironwork, water seals, frames and covers, and all work necessary for a completed structure.

B. If no such payment item exists in the Proposal, the work shall be deemed included under the other items of the Proposal.

END OF SECTION 334913

SECTION 335133.10 - PLUG VALVES

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Furnish and install valves at locations shown on the plans and in accordance with these specifications.

B. Furnish and provide valve boxes for all buried installations and at other locations shown on the Plans and in accordance with these specifications.

1.2 RELATED WORK:

A. Ductile Iron Pipe Water Pipe and Specials - Section 331113.13

B. Ductile Iron (D.I.) Pressure Sewer Pipe - Section 333113.14

1.3 EXISTING CONDITIONS:

A. It shall be the Contractor's responsibility to investigate all site conditions that may affect his work.

1.4 SUBMITTALS REQUIRED:

A. The Contractor shall not place any materials until such time that each material used in the work has been accepted by the Engineer.

B. Submittals shall comply with the requirements as delineated in the Contract General Conditions.

PART 2 - MATERIALS

2.1 VALVE (GENERAL):

A. Shall be manufactured by Val-Matic, DeZurik or an acceptable equal.

B. Shall turn ninety degrees (90B) to open and have a square operating nut.

C. The ends shall be push-on or mechanical joint with adapters for outside installations, at

the Contractor's option. Inside installations shall be flanged.

2.2 VALVE (CONSTRUCTION):

A. Shall be non-lubricated eccentric type with resilient faced plugs.

B. Valve bodies shall be semi-steel with raised seats.

C. Port areas of open valves shall be a minimum of 70%.

D. Resilient plug shall be of soft rubber-lined neoprene.

E. Valves of 3" and 4" size shall be furnished with an operating lever; over 4" shall be furnished with handwheels.

F. All overhead valves shall be furnished with chainwheel operators.

2.3 VALVE BOXES:

A. Shall be manufactured by James B. Clow & Sons, Inc., the Mueller Company, or an acceptable equal.

B. Shall be five and one-quarter (5I") inside diameter.

C. Shall be a two piece, cast iron, standard slide type, with cast iron cover of proper length for actual trench depth.

D. Each coverface shall be appropriately lettered "WATER" or "SEWER" (or other appropriate identification) and have an arrow indicating direction of opening.

PART 3 - CONSTRUCTION DETAILS

3.1 PLACEMENT (GENERAL):

A. Valves shall be installed in accordance with the manufacturer's instructions for the type of ends used at the location shown on the plans.

B. Valve boxes shall be centered and plumb over the operating nut, and the cover shall be set at finished grade of pavement or in areas outside pavement, at height acceptable to the Engineer.

C. Valve boxes shall be clear of dirt, stones or any other debris prior to acceptance.

D. Valve boxes shall not bear on the valve and shall be independently supported.

E. Valves shall be operated to determine that they are in correct operating condition and do not leak, prior to the completion of backfilling, after hydrostatic and leakage tests are completed.

F. Valve boxes shall be supported so they do not transmit shock or stress to the valve.

PART 4 - MEASUREMENT AND PAYMENT.

4.1 MEASUREMENT:

A. Unit of measurement shall be for each complete valve and valve box assembly properly installed.

4.2 PAYMENT:

A. Payment will be made based on the price bid per unit in the Proposal. Payment will be made for the completed assembly.

B. The price bid per unit shall include the cost for the valve, valve box and appurtenances required for the complete installation including all labor, equipment and materials as required to complete the work.

END OF SECTION – 335133.10

SECTION 400507 - HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY:

A. This Section includes the following hangers and supports for mechanical system piping and equipment:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Equipment supports.

B. All pipe stands, hangers, and supports indicated and identified on the plans are for general and conceptual purposes only and shall not be used solely for the final design.

C. Contractor shall retain a Professional Engineer to provide signed and sealed shop drawings as part of the delegated design for all process pipe stands, supports, and hangers.

1.3 REFERENCE STANDARDS:

A. MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS:

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Coordinate location of pipe supports and support type such that anchoring hardware does not adversely affect any concrete reinforcement or infringe upon restrictions of floor, wall, or ceiling construction materials or methods. Notify Engineer immediately of any conflicts prior to support placement.

1.5 SUBMITTALS:

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Powder-actuated fastener systems.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Pipe stands. Include Product Data for components.
4. Equipment supports.
5. All other pipe supports, hangers, and stands necessary to support all process equipment and piping.

C. Welding certificates.

1.6 QUALITY ASSURANCE:

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel." ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS:

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Available Manufacturers:

1. AAA Technology & Specialties Co., Inc.
2. Bergen-Power Pipe Supports.
3. B-Line Systems, Inc.; a division of Cooper Industries.

4. Carpenter & Paterson, Inc.
5. Empire Industries, Inc.
6. ERICO/Michigan Hanger Co.
7. Globe Pipe Hanger Products, Inc.
8. Grinnell Corp.
9. GS Metals Corp.
10. National Pipe Hanger Corporation.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.
14. Tolco Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS:

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS:

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Available Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
4. Power-Strut Div.; Tyco International, Ltd.
5. Thomas & Betts Corporation.
6. Tolco Inc.
7. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS:

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Available Manufacturers:

1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.
6. Value Engineered Products, Inc.

C. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with vapor barrier.

D. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS:

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Available Manufacturers:

a. Hilti, Inc.
b. ITW Ramset/Red Head.
c. Masterset Fastening Systems, Inc.
d. MKT Fastening, LLC.
e. Powers Fasteners.

B. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Available Manufacturers:

a. B-Line Systems, Inc.; a division of Cooper Industries.
b. Empire Industries, Inc.
c. Hilti, Inc.
d. ITW Ramset/Red Head.
e. MKT Fastening, LLC.
f. Powers Fasteners.

2.7 PIPE STAND FABRICATION:

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

1. Available Manufacturers:

a. ERICO/Michigan Hanger Co.
b. MIRO Industries.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

1. Available Manufacturers:

a. MIRO Industries.

D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.

1. Available Manufacturers:

a. ERICO/Michigan Hanger Co.
b. MIRO Industries.
c. Portable Pipe Hangers.

2. Base: Stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.

1. Available Manufacturers:

a. Portable Pipe Hangers.

2. Bases: One or more plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.8 EQUIPMENT SUPPORTS:

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.9 MISCELLANEOUS MATERIALS:

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 GENERAL:

A. The following tables are provided for general knowledge and is not intended to supersede the requirements herein:

ALLOWABLE SPACE OF PIPE HANGARS FOR DIP		
Pipe Size (in)	Unit Weight (lbs./ft)	Maximum Spacing (ft.)
2	13.3	15
4	17.6	15
6	30.5	15
8	46.9	15
10	66.5	10
12	90.8	8
14	121	6
16	154	5
18	187	4
Note: Weight assumes pipe is full of water at 73F.		

ALLOWABLE SPACE OF PIPE HANGARS FOR SCHEDULE 80 PVC		
Pipe Size (in)	Unit Weight (lbs./ft)	Maximum Spacing (ft.)
2	2.2	15
4	7.6	15
6	16.3	15
8	27.8	15
10	43.2	15
12	60.3	10
14	66.8	10
16	87.2	8
18	110.3	6
20	136.2	5
24	196.1	4
Note: Weight assumes pipe is full of water at 73F.		

3.2 HANGER AND SUPPORT APPLICATIONS:

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
9. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.

16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.

8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
3. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
4. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
5. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
6. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
7. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.

b. Vertical (MSS Type 55): Mounted vertically.
c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.3 HANGER AND SUPPORT INSTALLATION:

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof.

2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb.

G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

L. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

N. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.
    c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.

d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.4 EQUIPMENT SUPPORTS:

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.5 METAL FABRICATIONS:

A. Cut, drill, and fit miscellaneous metal fabrications for equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.6 ADJUSTING:

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.7 PAINTING:

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 Section "High-Performance Coatings."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 40 05 07

SECTION 400508 – PROCESS PIPING IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY:

A. This Section includes the following mechanical identification materials and their installation:
   1. Pipe markers.
   2. Stencils.
   3. Valve tags.
   4. Valve schedules.

1.3 RELATED SECTIONS:

A. SECTION 400552 - PROCESS VALVES

1.4 SUBMITTALS:

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Piping numbering scheme.

D. Piping Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

1.5 QUALITY ASSURANCE:

A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.6 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.

1. Data:

   a. Manufacturer, product name, model number, and serial number.
   b. Capacity, operating and power characteristics, and essential data.
   c. Labels of tested compliances.

2. Location: Accessible and visible.
3. Fasteners: As required to mount on equipment.

B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.

1. Terminology: Match schedules as closely as possible.
2. Data:

   a. Name and plan number.
   b. Equipment service.
   c. Design capacity.
   d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.

3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.

1. Data: Instructions for operation of equipment and for safety procedures.
2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
3. Thickness: 1/16 inch, unless otherwise indicated.
4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

D. Access Panel and Door Markers: 1/16-inch- thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.

1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.2 PIPING IDENTIFICATION DEVICES:

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

1. Colors: Comply with Ten States Standards, unless otherwise indicated.
2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Pretensioned Pipe Markers: Pre-coiled semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

C. Shaped Pipe Markers: Preformed semi-rigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.

D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.

1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

2.3 STENCILS:

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door markers, equipment markers, equipment signs, and similar operational instructions.

1. Stencil Material: Metal or fiberboard.
2. Stencil Paint: Exterior, gloss, alkyd enamel black, unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1, unless otherwise indicated.

2.4 VALVE TAGS:

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by Engineer. Provide 5/32-inch hole for fastener.

1. Material: 0.032-inch- thick brass.
2. Valve-Tag Fasteners: Brass S-hook.

2.5 VALVE SCHEDULES:

A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
2. Frame: Extruded aluminum.
3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.
4. See Section 400552 for more information regarding Process Valves and Valve Schedule.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL:

A. Products specified are for applications referenced in other Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 PIPING IDENTIFICATION:

A. Install manufactured pipe markers indicating service on each piping system. Piping systems with insulation shall have labels placed on top of insulation only. Install each label with flow indication arrows showing direction of flow.

1. Pipes with OD, Including Insulation, Less Than 6 Inches: Pre-tensioned pipe markers. Use size to ensure a tight fit.
2. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.

B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior non-concealed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and non-accessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

3.3 VALVE-TAG INSTALLATION:

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixtures an piping (specified in Division 22); and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units (specified in Division 23). List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:

1. Valve-Tag Size and Shape:

a. Cold Water: 1-1/2 inches, round.
b. Hot Water: 1-1/2 inches, round.
c. Gas: 1-1/2 inches, round.

3.4 ADJUSTING:

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.5 CLEANING:

A. Clean faces of mechanical identification devices.

END OF SECTION 400508

SECTION 400523 – STAINLESS STEEL PIPE AND FITTINGS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, equipment and incidentals required and install, test complete and ready for operation all wastewater stainless steel pipe as shown on the Drawings and as specified herein.

B. Where the word “pipe” is used, it shall refer to pipe, fittings, hangers, supports and appurtenances unless otherwise noted.

1.2 RELATED WORK

A. Valves and appurtenances are included in Section 400552 “Process Valves”

B. Pipe hangers and supports are included in Section 400507 “Hangers and Supports”

C. Pipe insulation is included in Section 404213 “Process Piping Insulation”

1.3 SUBMITTALS

A. The Contractor shall submit to the Engineer shop drawings and product data including piping layouts and schedules required to establish compliance with this section.

1. Proposed cleaning method, including precleaning, descaling, chemicals to be used, or mechanical descaling method and final cleaning/passivation.

2. Submit certification that welders are qualified, in accordance with ANSI B31.1, Paragraph 127.5 for shop and project site welding of pipe work.

1.4 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASTM)

1. ASTM A182- Standard Specification for Forged or Rolled Alloy – Steel Pipe Flanges, Forged Fittings and Valves and Parts for High – Temperature Service.

2. ASTM A312 – Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes.

3. ASTM A380 – Standard Practice for Cleaning and Descaling Stainless Steel Parts, Equipment and Systems.

4. ASTM A530 – Standard Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe.

5. ASTM A744 – Specification for As-Welded Wrought Austenitic Stainless Steel.

6. ASTM A778 – Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.

B. American National Standards Institute (ANSI)

1. ANSI B16.1 – Cast Iron Pipe Flanges and Flanged Fittings.

2. ANSI B16.9 – Factory-Made Wrought Steel Buttwelding Fittings.

3. ANSI B36.19 – Stainless Steel Pipe.

C. American Water Works Association (AWWA)

1. AWWA C111 – Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings.

D. American Society of Mechanical Engineers (ASME)

1. ASME B31.1 – Power Piping.

E. American Welding Society (AWS)

F. Where reference is made to one of the above standards, the revision in effect at the same time of bid opening shall apply.

1.5 QUALITY ASSURANCE

A. All stainless steel pipe and fittings shall be furnished by a single manufacturer who is fully experienced, reputable, qualified and regularly engaged for the last five years in the manufacture of the materials to be furnished. The pipe and fittings shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these Specifications.

1.6 SYSTEM DESCRIPTION

A. Piping shall be installed in those locations as shown on the Drawings.

B. The equipment and materials specified herein are intended to be standard types of stainless-steel pipe and fittings for use in transporting air and wastewater.

C. All stainless-steel pipe not specified shall be Type 316L unless otherwise specified on the Drawings.

1.7 DELIVERY, STORAGE AND HANDLING

A. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe and fittings. Pipe and fittings shall not be dropped. Pipe and fittings shall be examined before installation and no piece shall be installed which is found to be defective.

B. In handling the pipe, wide cushioned slings or other devices and methods acceptable to the Engineer shall be used. No uncushioned ropes, chairs, wedges or levers shall be used in handling the pipe, fittings and couplings.

C. If any defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe by the Contractor, at the Contractor's own expense. All pipe and fittings shall be thoroughly cleaned before installation and shall be kept clean until they are put into service.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All stainless steel pipe and fittings shall be Schedule 10S unless otherwise noted on the plans. All piping materials shall be welded; austenitic stainless steel pipe Grade Type 316L conforming to ASTM A778 and ANSI B36.19 for pipe and ASTM A744 for fittings. Finish shall be No. 1 or better.

B. All stainless steel pipe and fittings shall be fabricated from stainless steel sheet conforming to ASTM A778. Fittings shall be butt weld type manufactured in accordance with ASTM A774 of the same raw material and in the same thickness as the pipe. For all size fittings, the butt weld shall be full penetration, with a smooth ID.

C. Pipe shall be die-formed or rolled true to dimension and round. Tolerances, for length, inside and outside diameter and straightness shall conform to ASTM A530. The two edges of sheet shall be brought to line so as not to leave a shoulder on the inside of the pipe. Ends of pipe and fittings shall be perpendicular to the longitudinal axis. Longitudinal seams on pipe and fittings shall be welded by either the tungsten gas or the metallic-gas method. The interior welds shall be smooth, even and shall not have an internal bead higher than 1/16-in. All pieces shall be marked with gauge and type of stainless steel and with the initials of the inspector marked on the inside of each piece, at each end.

D. Flanges, flange bolts and rolled angle rings (where used) shall be of the same material as the pipe.

E. Pipe and fittings shall be fabricated true to dimension and round. Ends of pipe and fittings shall be perpendicular to the longitudinal axis. Pipes shall be straight within maximum of 1/8-inch deviation over 10-foot. Fittings shall be smooth curve type up to 18-in. in diameter, and mitered. Type 20-inch in diameter and greater. Fittings shall conform to ANSI B16.9.

F. Flanges for pipe 4-in and smaller should be of the type of stainless steel as the pipeline, and shall be welded directly to the pipe end, and shall be drilled to the 125 lb ANSI B16.1 standard. Flanges for pipe larger than 4-in shall have stub ends or rolled angle rings of the type of stainless

steel as the pipeline welded to the pipe end, with suitable gaskets between the mating surfaces and joined through the use of 125 lb rated back-up flanges, drilled to ANSI B16.1, and made of the same material stainless steel as the pipe. Where the pipe stub is to pass through a sleeve during installation, a split-type back up flange shall be used. Bolts, washers, nuts and other hardware for flange bolting shall be the same type stainless steel as the pipe.

G. Gaskets for flanged connections shall be a minimum of 1/16-in thick and shall be compatible with the fluid in the pipe and the temperature of the pipe.

H. Shop fabricated multiple output headers may be used in lieu of individual flanged fittings.

I. Wall pipes shall have integral shop welded wall stops.

J. All stainless steel pipe and fittings shall be manufactured by Douglas Brothers Division, Robert Mitchell, Co., Portland, ME; Felker Alloy Products, Marshfield, WI or equal.

K. Pipe Penetration

1. All stainless steel pipe and fittings shall be pickled at the point of manufacture, scrubbed and washed until all discoloration is removed. Fittings shall be shipped with end caps to prevent contamination. Pipe and fittings shall be cleaned with solvent. The finished piping shall be cleaned and provided with a No. 1 finish or better.

L. Pipe ends shall be prepared for couplings or other type ends where noted on the Drawings, or where otherwise required for disassembly.

1. All joints at valves shall be flanged.

2. Grooved couplings designed for build-up ends for schedules 5S and 10S only; roll grooving will not be permitted; Pressfit couplings, manufactured by the Victaulic Co. may be used on pipe sizes 1-1/2 inch and smaller.

3. Where shown on the drawings or where approved by the Engineer, flanged coupling adaptors shall be used to connect plain end pipe to equipment, fittings and valves. Flanged coupling adaptors shall be of the Type 316L stainless steel and shall be style 38 as manufactured by Dresser Manufacturing Division of Dresser Industries; coupling 411 as manufactured by Smith Blair, Inc. or equivalent couplings manufactured by Depend-O-Lok Co.

4. The Contractor is responsible for ensuring the accuracy of make-up of all joints in full compliance with the manufacturer's specifications. All normal pipe joints at valves, bends, etc. shall be flanged, drilling per ANSI B16.1, Class 125.

M. Shop welding of fabrications shall be done according to the procedures and by welders certified per ASME Section IX. Welds shall be by an inert gas shielding process using only extra low carbon filler metals. Welds shall have a bead height of no more than 1/16-in. Butt welds shall have 100 percent penetration to the interior or backside of the weld joint. Cross-sectional thickness of welds shall be equal or greater than that of the parent metal.

N. Pipeline expansion joints shall meet the requirements of Section 15120 and shall be located per the requirements of Section 15140.

O. The Contractor shall furnish specifications and qualification records of welding procedure for pipe welding to be performed under this Section, in accordance with Section IX, Article III, of the ASTM Boiler and Pressure Vessel Code. Also, submit a list of welders contractor proposes using, and the type of welding for which each has been qualified.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All stainless steel pipe shall be installed as specified in Section 15051 and as specified below.

B. Pipe supports shall be provided in accordance with Section 15140 and arranged to allow for thermal expansion of the pipe over the specified temperature range, and shall allow the longitudinal movement except at anchorage points.

C. All pipe and fittings shall be installed true to grade and alignment and pipe anchorage and/or restraint shall be provided where required. Manufacturer's instructions shall be strictly followed.

D. Pipe and fittings shall be protected from dirt, dust, oil, grease and other foreign matter during installation to prevent damage to pipe and to assure no foreign matter is left in the piping.

E. To assemble the joints in the fields, thoroughly clean all joint surfaces and gaskets, if any, with soapy water before assembly. Bolts should be tightened alternately, evenly to the manufacturer's specified torques. Under no condition shall extension wrenches or pipe-over-handle ratchet wrenches be used to secure greater leverage. All electrical bonding or insulation shall be installed as joints are made up.

F. Fittings, in addition to those shown on the Drawings, shall be provided if required. Due consideration shall be given to thermal expansion/contraction over a temperature range of 200 degrees F.

G. Sleeves of the proper size shall be installed for all pipes passing through floors or walls as shown on the Drawings. Sleeves shall be as specified in Section 01172.

H. When cutting of pipe is required, the cutting shall be done by machine neatly, without damage to the pipe. Cut ends shall be smooth and at right angles to the axis of the pipe.

I. After installation, stainless steel pipe lines shall be washed clean with steam or hot water to remove any foreign material picked up during transport.

3.2 JOINING MECHANICAL AND RESTRAINED JOINTS

A. Mechanical joints shall be in accordance with the "Notes on Methods of Installation" under AWWA C111 and the instructions of the manufacturer.

B. Restrained joint pipe and fittings shall be installed in the locations shown on the Drawings and as acceptable to the Engineer.

3.3 JOINING FLANGED JOINTS

A. Flanged joints shall be made with gasket, bolts and nut bolts with a nut on each end, or studs with nuts where the pipe is tapped. The number and size of bolts shall conform to the same standard requirements as the flange.

3.4 FIELD WELDING

A. Welding in the field shall be done only if approved by the Engineer. Field welds shall be made by welders certified under ASME Section IX and be equal in all respects to shop welds. After field welding has been done, all joints shall be thoroughly cleaned and buffed using deburring and finishing wheels.

3.5 FIELD PAINTING

A. Final field painting is included in Section 099600 “High Performance Coatings” except that for all stainless steel pipe, only bands, labels and arrows rather than full pipe painting will be required.

3.6 DISINFECTION AND CLEANUP

A. After installation, completed lines shall be cleaned with Oakite deoxidizer as recommended by the manufacturer to remove all foreign matter, construction stains or shop markings. Cleaned lines shall be rinsed clear with steam or hot water.

3.7 FIELD TESTING

A. All pipelines shall be tested for compliance with ASTM A312/A312M-01. If leaks are discovered, they shall be repaired under this Section. Repairs shall be approved by the Engineer. Hydrostatic pressure test will be required.

END OF SECTION 400523

SECTION 400551 – COMMON REQUIREMENTS FOR PROCESS VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY:

A. Contractor shall furnish all labor, materials, tools and equipment as necessary to install process valves of the type, and at locations shown in the Contract Plans. Individual Division 40 valve specifications may have supplemental requirements.

B. Contractor shall furnish all labor, materials, tools and equipment as necessary to install process valve actuators and appurtenances.

C. Division 22, 23, and 46 valves have differing requirements that are specified in those respective divisions. This Section shall not apply to the valves specified in those Divisions.

1.3 RELATED SECTIONS:

A. Division 09 Section “High Performance Coatings”.

B. Division 46 Sections for valve requirements for the belt press and polymer systems respectively.

1.4 DEFINITIONS:

A. The following are industry abbreviations for materials:
   1. HDPE: High-density Polyethylene.
   2. PVC: Polyvinyl Chloride.
   3. DIP: Ductile Iron Pipe.

1.5 REFERENCE STANDARDS:

A. Referenced Standards:
   1. American Society of Mechanical Engineers (ASME):
      a. B1.20.1, Pipe Threads, General Purpose.
      b. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
      c. B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
   2. ASTM International (ASTM):
      a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

b. D256, Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
c. D638, Standard Test Method for Tensile Properties of Plastics.
d. D648, Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
e. D695, Standard Test Method for Compressive Properties of Rigid Plastics.
f. D2240, Standard Test Method for Rubber Property-Durometer Hardness.

3. American Water Works Association (AWWA):
   a. C207, Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 IN through 144 IN.
   b. C500, Standard for Metal-Seated Gate Valves for Water Supply Service.
   c. C504, Standard for Rubber-Seated Butterfly Valves.
   d. C507, Standard for Ball Valves, 6 IN through 48 IN (150 MM through 1,200 MM).
   e. C509, Standard for Resilient-Seated Gate Valves for Water Supply Service.
   f. C541, Standard for Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates.
   g. C542, Standard for Electric Motor Actuators for Valves and Slide Gates.
   h. C550, Standard for Protective Coatings for Valves and Hydrants.
   i. C606, Standard for Grooved and Shouldered Joints.

4. American Water Works Association/American National Standards Institute (AWWA/ANSI):
   a. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

5. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
   b. MG 1, Motors and Generators.

1.6 SUBMITTALS:

A. All iron and steel products used in the Work must be produced in the United States and certifications of such production must be provided to the Owner prior to installation.

B. Shop Drawings:
   1. Product technical data including:
      a. Manufacturer's installation instructions.
      b. Valve pressure and temperature rating.
      c. Valve material of construction.
      d. Special linings.
      e. Valve dimensions and weight.
      f. Valve flow coefficient.
      g. Wiring and control diagrams for electric or cylinder actuators.

   2. Test reports.

C. Operation and Maintenance Manuals.

D. Informational Submittals: Verification from valve actuator manufacturer that actuators have been installed properly, that all limit switches and position potentiometers have been properly adjusted, and that the valve actuator responds correctly to the valve position command.

1.7 QUALITY ASSURANCE:

A. Valve manufacturers shall have a minimum of ten (10) years experience in the manufacture of the type of valve proposed in the fluid, temperature, and pressure services provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. As specified in individual valve sections.

B. Manufacturer's listed are "design basis" manufacturers with "design basis" valve models.

2.2 MATERIALS:

A. As specified in individual valve specifications.

2.3 ACTUATORS:

A. Manual valves shall be utilized.

2.4 FABRICATION:

A. End Connections:
   1. Provide the type of end connections for valves as required in the Piping Schedules as shown on the Drawings or specified in Division 40.
   2. Comply with the following standards:
      a. Threaded: ASME B1.20.1.
      b. Flanged: ASME B16.1, Class 125 unless otherwise noted or AWWA C207.
      c. Bell and spigot or mechanical (gland) type: AWWA/ANSI C111/A21.11.
      d. Soldered: ASME B16.18.
      e. Grooved: Rigid joints per Table 5 of AWWA C606.

B. Refer to individual valve Specification Sections for respective supplemental requirements for each type of valve used.

C. Nuts, Bolts, and Washers:
   1. Wetted or internal to be bronze or stainless steel.
   2. Exposed to be zinc or cadmium plated.

D. On Insulated Piping: Provide valves with extended stems to permit proper insulation application without interference from handle.

E. Epoxy Interior Coating: Provide epoxy interior coating for all ferrous surfaces in accordance with AWWA C550.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install products in accordance with manufacturer's instructions.

B. Painting Requirements: Comply with Division 09 “High Performance Coatings” semi-gloss severe service requirements for painting and protective coatings.

C. Support exposed valves and piping adjacent to valves independently to eliminate pipe loads being transferred to valve and valve loads being transferred to the piping.

D. For grooved coupling valves, install rigid type couplings or provide separate support to prevent rotation of valve from installed position.

E. Install electric or cylinder actuators above or horizontally adjacent to valve and gear box to optimize access to controls and external handwheel.

F. For threaded valves, provide union on 1 side within 2 FT of valve to allow valve removal.

G. Install valves accessible for operation, inspection, and maintenance.

3.2 ADJUSTMENT:

A. Adjust valves, actuators and appurtenant equipment to open and close at system pressures.

END OF SECTION 400551

SECTION 400552 - PROCESS VALVES

PART 1 – GENERAL

1.1 SUMMARY:

A. Contractor shall furnish all labor, materials, tools and equipment as necessary to install process valves of the type, and at locations shown in the Contract Plans. Individual Division 40 valve specifications may have supplemental requirements.

B. Contractor shall furnish all labor, materials, tools and equipment as necessary to install process valve actuators and appurtenances.

C. This Section includes the following general-duty valves:

1. VALVE SCHEDULE
2. Ball Valves
3. BALL VALVES (PVC, CPVC, PP AND PVDF)
4. Ball Check Valve
5. Butterfly Valves
6. Butterfly Valves Air Service
7. Eccentric Plug Valves
8. Resilient Disc Gate Valve
9. Knife Gate Valve
10. Mud Valves

1.2 RELATED SECTIONS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Division 40 Section “Actuators for Process Valves” for actuator requirements.

C. SECTION 400565- BALL CHECK VALVES

D. SECTION 331216.03 - BUTTERFLY VALVES

E. SECTION 331216.02 - BUTTERFLY VALVES AIR SERVICE

F. SECTION 335133.10 - PLUG VALVES

G. SECTION 331216.01.S - RESILIENT-DISC GATE VALVE

H. SECTION 400561.43 - KNIFE GATE VALVES

I. SECTION 400508 – PROCESS PIPING IDENTIFICATION

1.3 REFERENCE STANDARDS:

A. American Society of Mechanical Engineers (ASME):

1. B1.20.1, Pipe Threads, General Purpose.
2. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
3. B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.

B. ASTM International (ASTM):

1. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
2. D256, Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
3. D638, Standard Test Method for Tensile Properties of Plastics.
4. D648, Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
5. D695, Standard Test Method for Compressive Properties of Rigid Plastics.
6. D2240, Standard Test Method for Rubber Property-Durometer Hardness.

C. American Water Works Association (AWWA):

1. C207, Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 IN through 144 IN.
2. C500, Standard for Metal-Seated Gate Valves for Water Supply Service.
3. C504, Standard for Rubber-Seated Butterfly Valves.
4. C507, Standard for Ball Valves, 4 IN through 60 IN
5. C509, Standard for Resilient-Seated Gate Valves for Water Supply Service.
6. C541, Standard for Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates.
7. C542, Standard for Electric Motor Actuators for Valves and Slide Gates.
8. C550, Standard for Protective Coatings for Valves and Hydrants.
9. C606, Standard for Grooved and Shouldered Joints.

D. American Water Works Association/American National Standards Institute (AWWA/ANSI):

1. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

1.4 SUBMITTALS:

A. Product data for valves including details of construction relative to materials, dimensions of individual components, profiles, operation, and finishes.

B. Shop Drawings:

1. Product technical data including:
   a. Manufacturer's installation instructions.
   b. Valve pressure and temperature rating.
   c. Valve material of construction.
   d. Special linings.

e. Valve dimensions and weight.
f. Valve flow coefficient.
g. Wiring and control diagrams for electric or cylinder actuators.

2. Test reports.

B. Operation and Maintenance Manuals.

C. Informational Submittals: Verification from valve actuator manufacturer that actuators have been installed properly, that all limit switches and position potentiometers have been properly adjusted, and that the valve actuator responds correctly to the valve position command.

1.5 QUALITY ASSURANCE:

A. Obtain components from a single source having responsibility and accountability to answer and resolve problems regarding proper installation, compatibility, performance, and acceptance.

B. Valve manufacturers shall have a minimum of ten (10) years experience in the manufacture of the type of valve proposed in the fluid, temperature, and pressure services provided

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Deliver double-containment piping as a factory assembled unit with protective wrapping/coverings.

B. Store products on elevated platforms in a dry location with protection from elements.

C. Lift, support, and transport per manufacturer's recommendations.

1.7 WARRANTY:

A. Warranty period is one year after date of substantial completion of installation.

1.8 EXTRA MATERIALS:

A. Turn over to owner, at end of construction, necessary Assembly, Maintenance, and Operating Instructions as suggested by manufacturer.

PART 2 – PRODUCTS

2.1 GENERAL:

A. Subject to the compliance with requirements, valves that may be incorporated into the work specified below are basis of design manufacturer's and models. Approved equal valves are to be

evaluated based upon performance criteria specified below.

2.2 VALVE SCHEDULE

A. The following Valve Schedule is provided for reference to the Contractor. The contractor is responsible for verifying all gates shown on the plans prior to purchase and installation.

PROJECT LOCATION	ASSOC. EQUIP.	SIZE	TYPE	QUANTITY	CONNECTION TYPE	ACTUATION	TAG ID	PROVIDED BY
C-200s								
C-213								
PROPOSED HEADWORKS	GRIT CHAMBER/ WASHERS 1 AND 2	4	PINCH VALVE	2	FLANGED	AIR	2-PIV-1/2	MANUFACTURER
PROPOSED HEADWORKS	GRIT CHAMBER/ WASHERS 1 AND 2	3	BALL VALVE	2	NPT	ELECTRIC	2-BV-1/2	MANUFACTURER
PROPOSED HEADWORKS	GRIT CHAMBER/ WASHERS 1 AND 2	2	BALL VALVE	2	NPT	MANUAL	2-BV-3/4	MANUFACTURER
C-250								
PROPOSED BARSCREEN BUILDING	GRIT WASHERS 1 AND 2 PLANT WATER SUPPLY	1	BALL VALVE	2	TRUE UNION	MANUAL	2-BV-5/6	CONTRACTOR
PROPOSED BARSCREEN BUILDING	PVC PLANT WATER SUPPLY	4	BALL VALVE	1	TRUE UNION	MANUAL	2-BV-7	CONTRACTOR
PROPOSED BARSCREEN BUILDING	PROPOSED BARSCREEN 2 PLANT WATER SUPPLY	1/2	BALL VALVE	1	TRUE UNION	MANUAL	2-BV-8	CONTRACTOR
PROPOSED GRIT CHAMBER 2	PROPOSED GRIT WASHER 2 PLANT WATER SUPPLY	1 1/2	BALL VALVE	1	TRUE UNION	MANUAL	2-BV-9	CONTRACTOR
C-250								
EXISTING GRIT CHAMBER 1	EXISTING GRIT CHAMBER 1 PLANT WATER SUPPLY	1 1/2	BALL VALVE	1	TRUE UNION	MANUAL	2-BV-10	CONTRACTOR
C-250								
EXISTING BARSCREEN BUILDING	PVC PLANT WATER SUPPLY	4	BALL VALVE	2	TRUE UNION	MANUAL	2-BV-11/12	CONTRACTOR
EXISTING BARSCREEN BUILDING	PROPOSED BARSCREEN 1 PLANT WATER SUPPLY	1/2	BALL VALVE	1	TRUE UNION	MANUAL	2-BV-13	CONTRACTOR
C-300s								
C-301, 311								
PRIMARY SETTLING TANK 1/2/3/4 SCUM PIT	SCUM PUMP DISCHARGE	3	PLUG VALVE	4	FLANGED	MANUAL	3-PV-1/2/3/4	CONTRACTOR
PRIMARY SETTLING TANK 1/2/3/4 SCUM PIT	SCUM PUMP DISCHARGE	4	PLUG VALVE	4	FLANGED	MANUAL	3-PV-5/6/7/8	CONTRACTOR
PRIMARY SETTLING TANK 1/2/3/4 SCUM PIT	SCUM PUMP DISCHARGE	3	BALL CHECK VALVE	4	FLANGED	MANUAL	3-CV-1/2/3/4	CONTRACTOR
PRIMARY SETTLING TANK 1/2/3/4	TANK FLOOR	4	GROUNDWATER RELIEF VALVE	16	CAST	HYDROSTATIC	3-GWRV-1/2/3/…/15/16	CONTRACTOR
C-320								
EXISTING PRIMARY SLUDGE VALVE PIT	6" DUCTILE IRON PRIMARY CLARIFIER COMMON HEADER	6	RESILIENT WEDGE GATE VALVE	7	FLANGED	MANUAL	3-RWGV-1/2/3/4/5/6/7	CONTRACTOR
EXISTING PRIMARY SLUDGE VALVE PIT	6" DUCTILE IRON PRIMARY CLARIFIER COMMON HEADER	6	PLUG VALVE	3	FLANGED	ELECTRIC ACTUATOR	PS-AV-01/02/03	CONTRACTOR
C-320								
PRIMARY CLARIFIER #4 SLUDGE VALVE PIT	6" SLUDGE DISCHARGE	6	RESILIENT WEDGE GATE VALVE	2	FLANGED	MANUAL	3-RWGV-8/9	CONTRACTOR
PRIMARY CLARIFIER #4 SLUDGE VALVE PIT	6" SLUDGE DISCHARGE	6	PLUG VALVE	1	FLANGED	ELECTRIC ACTUATOR	PS-AV-04	CONTRACTOR
C-322								
EXISTING PRIMARY SLUDGE PUMP PIT	EXISTING PRIMARY SLUDGE PIT UPPER LEVEL	4	RESILIENT WEDGE GATE VALVE	2	FLANGED	MANUAL	3-RWGV-10/11	CONTRACTOR
EXISTING PRIMARY SLUDGE PUMP PIT	EXISTING PRIMARY SLUDGE PIT UPPER LEVEL	4	CHECK VALVE	2	FLANGED	MANUAL	3-CV-5/6	CONTRACTOR
C-322								
EXISTING PRIMARY SLUDGE PUMP PIT	EXISTING PRIMARY SLUDGE PIT LOWER LEVEL	4	GATE VALVE	2	FLANGED	MANUAL	3-RWGV-12/13	CONTRACTOR
C-400s								
C-410								
ATAD EQUIPMENT BUILDING	ROTARY DRUM THICKENER SLUDGE FEED PUMP	4	BALL VALVE	2	FLANGED	MANUAL	4-BV-1/2	CONTRACTOR
C-410								
SLUDGE HOLDING TANK	DIMJ PRIMARY SLUDGE	6	GATE VALVE	1	FLANGED	MANUAL	4-RWGV-1	CONTRACTOR
SLUDGE HOLDING TANK	DIMJ W.A.S	4	GATE VALVE	1	FLANGED	MANUAL	4-RWGV-2	CONTRACTOR
SLUDGE HOLDING TANK	TEMPORARY SLUDGE WITHDRAWAL	4	GATE VALVE	1	FLANGED	MANUAL	4-RWGV-3	CONTRACTOR
SLUDGE HOLDING TANK	8" SS AIR SUPPLY HEADER	8	BUTTERFLY VALVE	2	LUG	MANUAL		ATAD SUPPLIER
C-411								
OUTSIDE ATAD EQUIPMENT BUILDING	PRECAST FILTRATE PUMP STATION	4	CHECK VALVE	2	FLANGED	MANUAL	4-CV-1/2	CONTRACTOR
OUTSIDE ATAD EQUIPMENT BUILDING	PRECAST FILTRATE PUMP STATION	4	BALL VALVE	2	FLANGED	MANUAL	4-BV-3/4	CONTRACTOR
C-420								
THERMAER 1 AND 2	INBETWEEN THERMAER 1 AND 2	10	PLUG VALVE	1	FLANGED	MANUAL	4-PV-1	CONTRACTOR

C-422, 440, 441, P&IDs								
ATAD EQUIPMENT BUILDING	THERMAER 1 JET PUMP	16	PLUG VALVE	2	FLANGED	HAND/CHAIN WHEEL	V-101A/B	CONTRACTOR
ATAD EQUIPMENT BUILDING	THERMAER 1 JET PUMP	12	PLUG VALVE	1	FLANGED	CHAIN WHEEL	V-101C	CONTRACTOR
ATAD EQUIPMENT BUILDING	THERMAER 1 JET PUMP	1	BALL VALVE	5	TH	1/4 TURN HANDLE	V-101E/F/K/M/N	ATAD SUPPLIER
ATAD EQUIPMENT BUILDING	THERMAER 1 JET PUMP	2	BALL VALVE	2	TH	1/4 TURN HANDLE	V-1011/J	ATAD SUPPLIER
ATAD EQUIPMENT BUILDING	THERMAER 1 JET PUMP	4	PLUG VALVE	1	FLANGED	HAND WHEEL	V-105	CONTRACTOR
ATAD EQUIPMENT BUILDING	THERMAER 1 JET PUMP	2	CHECK VALVE	1	TH	N/A	V-103C	ATAD SUPPLIER
ATAD EQUIPMENT BUILDING	THERMAER 1 JET PUMP	1 1/2	BALL VALVE	1	TH	1/4 TURN HANDLE	V-104	ATAD SUPPLIER
ATAD EQUIPMENT BUILDING	THERMAER 1 JET PUMP	8	BUTTERFLY VALVE	1	LUG	MANUAL	V-103E	CONTRACTOR
ATAD EQUIPMENT BUILDING	THERMAER 1 JET PUMP	3/4	BALL VALVE	1	PUMP SKID		4-BV-5	ATAD SUPPLIER
ATAD EQUIPMENT BUILDING	THERMAER 1 PID FEED	6	PLUG VALVE	1	FLANGED	O/C ELECTRIC	V-811	ATAD SUPPLIER
ATAD EQUIPMENT BUILDING	THERMAER 1 PID TRANSFER	6	PLUG VALVE	2	FLANGED	O/C ELECTRIC	V-910, 913	ATAD SUPPLIER
ATAD EQUIPMENT BUILDING	THERMAER 1 OFF GAS	12	BF DAMP VALVE	1	FLANGED	1/4 TURN HANDLE	V-701A	ATAD SUPPLIER
C-422, 440, 441, P&IDs								
ATAD EQUIPMENT BUILDING	THERMAER 2 JET PUMP	16	PLUG VALVE	2	FLANGED	HAND/CHAIN WHEEL	V-201A/B	CONTRACTOR
ATAD EQUIPMENT BUILDING	THERMAER 2 JET PUMP	12	PLUG VALVE	1	FLANGED	CHAIN WHEEL	V-201C	CONTRACTOR
ATAD EQUIPMENT BUILDING	THERMAER 2 JET PUMP	1	BALL VALVE	5	TH	1/4 TURN HANDLE	V-201E/F/K/M/N	ATAD SUPPLIER
ATAD EQUIPMENT BUILDING	THERMAER 2 JET PUMP	2	BALL VALVE	2	TH	1/4 TURN HANDLE	V-2011/J	ATAD SUPPLIER
ATAD EQUIPMENT BUILDING	THERMAER 2 JET PUMP	4	PLUG VALVE	1	FLANGED	HAND WHEEL	V-205	CONTRACTOR
ATAD EQUIPMENT BUILDING	THERMAER 2 JET PUMP	2	CHECK VALVE	1	TH	N/A	V-203C	ATAD SUPPLIER
ATAD EQUIPMENT BUILDING	THERMAER 2 JET PUMP	1 1/2	BALL VALVE	1	TH	1/4 TURN HANDLE	V-204	ATAD SUPPLIER
ATAD EQUIPMENT BUILDING	THERMAER 2 JET PUMP	8	BUTTERFLY VALVE	1	LUG	MANUAL	V-203E	CONTRACTOR
ATAD EQUIPMENT BUILDING	THERMAER 2 JET PUMP	3/4	BALL VALVE	1	PUMP SKID		4-BV-6	ATAD SUPPLIER
ATAD EQUIPMENT BUILDING	THERMAER 2 PID FEED	6	PLUG VALVE	1	FLANGED	O/C ELECTRIC	V-812	ATAD SUPPLIER
ATAD EQUIPMENT BUILDING	THERMAER 2 PID TRANSFER	6	PLUG VALVE	2	FLANGED	O/C ELECTRIC	V-911, 914	ATAD SUPPLIER
ATAD EQUIPMENT BUILDING	THERMAER 2 OFF GAS	12	BF DAMP VALVE	1	FLANGED	1/4 TURN HANDLE	V-701B	ATAD SUPPLIER
C-422, 440, 441, P&IDs								
ATAD EQUIPMENT BUILDING	SNDR JET PUMP	16	PLUG VALVE	2	FLANGED	HAND/CHAIN WHEEL	V-401A/B	CONTRACTOR
ATAD EQUIPMENT BUILDING	SNDR JET PUMP	12	PLUG VALVE	1	FLANGED	CHAIN WHEEL	V-401C	CONTRACTOR
ATAD EQUIPMENT BUILDING	SNDR JET PUMP	1	BALL VALVE	5	TH	1/4 TURN HANDLE	V-401E/F/K/M/N	ATAD SUPPLIER
ATAD EQUIPMENT BUILDING	SNDR JET PUMP	2	BALL VALVE	2	TH	1/4 TURN HANDLE	V-4011/J	ATAD SUPPLIER
ATAD EQUIPMENT BUILDING	SNDR JET PUMP	2	CHECK VALVE	1	TH	N/A	V-403C	ATAD SUPPLIER
ATAD EQUIPMENT BUILDING	SNDR JET PUMP	1 1/2	BALL VALVE	1	TH	1/4 TURN HANDLE	V-404	ATAD SUPPLIER
ATAD EQUIPMENT BUILDING	SNDR JET PUMP	4	PLUG VALVE	1	FLANGED	HAND WHEEL	V-405	CONTRACTOR
ATAD EQUIPMENT BUILDING	SNDR JET PUMP	3/4	BALL VALVE	1	PUMP SKID		4-BV-7	ATAD SUPPLIER
ATAD EQUIPMENT BUILDING	SNDR PID TRANSFER	6	PLUG VALVE	2	FLANGED	O/C ELECTRIC	V-912, 915	ATAD SUPPLIER
ATAD EQUIPMENT BUILDING	SNDR OFF GAS	1/2	BALL VALVE	1	TH	1/4 TURN HANDLE	V-700A	ATAD SUPPLIER
ATAD EQUIPMENT BUILDING	SNDR OFF GAS	16	BF DAMP VALVE	2	FLANGED	1/4 TURN HANDLE	V-701C/E	ATAD SUPPLIER
ATAD EQUIPMENT BUILDING	SNDR OFF GAS	30	BF DAMP VALVE	1	FLANGED	1/4 TURN HANDLE	V-701D	ATAD SUPPLIER
ATAD EQUIPMENT BUILDING	SNDR OFF GAS	24X24	DILUTION	1	FLANGED	ELECTRIC	V-702	ATAD SUPPLIER
C-442, P&IDs								
ATAD EQUIPMENT BUILDING	TRANSFER PUMP 1	6	PLUG VALVE	2	FLANGED	HAND/CHAIN WHEEL	V-901A/B	CONTRACTOR
ATAD EQUIPMENT BUILDING	TRANSFER PUMP 1	1	BALL VALVE	3	TH	1/4 TURN HANDLE	V-901F/M/N	ATAD SUPPLIER
C-442, P&IDs								
ATAD EQUIPMENT BUILDING	TRANSFER PUMP 2	6	PLUG VALVE	2	FLANGED	HAND WHEEL	V-902A/B	CONTRACTOR
ATAD EQUIPMENT BUILDING	TRANSFER PUMP 2	1	BALL VALVE	4	TH	1/4 TURN HANDLE	V-901 E, 902F/M/N	ATAD SUPPLIER
C-442, P&IDs								
ATAD EQUIPMENT BUILDING	WATER PANEL OFF GAS	2	BALL VALVE	2	WATER PANEL	ELECTRIC	V-704, 705	ATAD SUPPLIER
C-442, P&IDs								
ATAD EQUIPMENT BUILDING	THERMAER 1 AND 2/ SNDR/ TRANSFER PUMP 1 AND 2 PLANT WATER PUMP SEAL	1/2	BALL VALVE	10	TH	1/4 TURN HANDLE	V-101L/P; 201L/P, 401L/P, 901L/P, 902L/P	ATAD SUPPLIER
ATAD EQUIPMENT BUILDING	THERMAER 1 AND 2/ SNDR/ TRANSFER PUMP 1 AND 2 PLANT WATER PUMP SEAL	1/2	SOLENOID VALVE	5	TH	ELECTRIC	SV-101, 201, 401, 901, 902	ATAD SUPPLIER
ATAD EQUIPMENT BUILDING	THERMAER 1 AND 2/ SNDR/ TRANSFER PUMP 1 AND 2 PLANT WATER PUMP SEAL	1/2	PRESSURE REDUCING VALVE	5	TH	PRESSURE SET	PRV-101, 201, 401, 901, 902	ATAD SUPPLIER

C-443, P&IDs								
ATAD EQUIPMENT BUILDING	COOLAER PID TRANSFER	6	PLUG VALVE	4	FLANGED	1/4 TURN HANDLE	V-914C/D/E/F	CONTRACTOR
ATAD EQUIPMENT BUILDING	COOLAER PID TRANSFER	6	PLUG VALVE	1	FLANGED	O/C ELECTRIC	V-918	ATAD SUPPLIER
ATAD EQUIPMENT BUILDING	COOLAER PID TRANSFER	1	BALL VALVE	6	TH	1/4 TURN HANDLE	V-953A/B/C/D/E/F	ATAD SUPPLIER
C-444, P&IDs								
ATAD EQUIPMENT BUILDING	SLUDGE HOLDING/SNDR/THERMAER 1+2 BLOWER	8	BUTTERFLY VALVE	4	FL	1/4 TURN HANDLE	V-103D, 203D, 403D, 503D	CONTRACTOR
ATAD EQUIPMENT BUILDING	SPARE/SLUDGE HOLDING/SNDR/THERMAER 1+2 BLOWER	6	BUTTERFLY VALVE	5	FL	1/4 TURN HANDLE	V-1103B, 103B, 203B, 403B, 503B	CONTRACTOR
ATAD EQUIPMENT BUILDING	SPARE/SLUDGE HOLDING/SNDR/THERMAER 1+2 BLOWER	5	CHECK VALVE	5	TH	N/A	V-1103A, 103A, 203A, 403A, 503A	ATAD SUPPLIER
C-444, P&IDs								
ATAD EQUIPMENT ROOM	SLUDGE HOLDING BLOWER TO SLUDGE HOLDING	2	ANTI SIPHON CHECK VALVE	1	TH	N/A	V-503C	ATAD SUPPLIER
C-421, 430, 440								
ATAD EQUIPMENT ROOM	LINE CONNECTING TO CAVITY SLUDGE BELT PRESS FEED PUMP	6	PLUG VALVE	2	FLANGED	MANUAL	4-PV-2/3	CONTRACTOR
ATAD EQUIPMENT ROOM	CAVITY SLUDGE BELT PRESS FEED PUMP	6	VALVE	2	FLANGED	MANUAL	4-PV-4/5	CONTRACTOR

C-500s								
C-510, 511								
INFLUENT DRYWELL	INFLUENT DRYWELL PUMP SUCTION	16	RESILIENT WEDGE GATE VALVE	3	FLANGED	MANUAL	5-RWGV-1/2/3	CONTRACTOR
INFLUENT DRYWELL	INFLUENT DRYWELL PUMP SUCTION	14	RESILIENT WEDGE GATE VALVE	3	FLANGED	MANUAL	5-RWGV-4/5/6	CONTRACTOR
INFLUENT DRYWELL	INFLUENT DRYWELL PUMP SUCTION	14	BALL CHECK VALVE	3	FLANGED	MANUAL	5-CV-1/2/3	CONTRACTOR
C-510								
MICROSCREEN AREA	MICROSCREEN 1 AND 2 PLANT WATER CONNECTION	6	SCH80 PVC TRUE UNION BALL VALVE	1	TRUE UNION	MANUAL	5-BV-1	CONTRACTOR
MICROSCREEN AREA	MICROSCREEN 1 AND 2 PLANT WATER CONNECTION	2	SCH80 PVC TRUE UNION BALL VALVE	2	TRUE UNION	MANUAL	5-BV-2/3	CONTRACTOR
C-520, 530, 531, VEOLIA P&IDs								
ANOXIC AND AEROBIC TANKS	STANDPIPE PUMP CONNECTION FOR TANK DRAINS	6	RESILIENT WEDGE GATE VALVE	3	FLANGED	MANUAL	5-RWGV-7/8/9	CONTRACTOR
ANOXIC AND AEROBIC TANKS	TANK DRAINS	6	MUD VALVE	9	FLANGED	MANUAL	5-MV-1/2/3/4/5/6/7/8/9	CONTRACTOR
ANOXIC AND AEROBIC TANKS	AEROBIC ZONE 1,2,3	8	BUTTERFLY VALVE	3	LUG	MANUAL	16-HV-405-1/2/3	VEOLIA
ANOXIC AND AEROBIC TANKS	AEROBIC ZONE 4,5,6	6	BUTTERFLY VALVE	3	LUG	MANUAL	16-HV-406-1/2/3	VEOLIA
C-542								
CASSETTE LAYDOWN AREA/ 1ST FLOOR	SECTION THROUGH SCUM PIT	6	GATE VALVE	2	FLANGED	MANUAL	5-RWGV-10/11	CONTRACTOR
CASSETTE LAYDOWN AREA/ 1ST FLOOR	SECTION THROUGH SCUM PIT	4	GATE VALVE	2	FLANGED	MANUAL	5-RWGV-12/13	CONTRACTOR
CASSETTE LAYDOWN AREA/ 1ST FLOOR	SECTION THROUGH SCUM PIT	4	CHECK VALVE	2	FLANGED	MANUAL	5-CV-4/5	CONTRACTOR
C-541, 542, VEOLIA P&IDs								
CITRIC ACID CHEM AREA	CITRIC ACID FEED PUMP SKID	1 1/2	SCH80 PVC BALL VALVE	2	TRUE UNION	MANUAL	5-BV-4/5	CONTRACTOR
CITRIC ACID CHEM AREA	CITRIC ACID FEED PUMP SKID	1 .5	BALL VALVE	3	CITRIC ACID SKID		23-HV-308, 306-A/B	VEOLIA
CITRIC ACID CHEM AREA	CITRIC ACID FEED PUMP SKID	1 1/2	BALL VALVE	6	CITRIC ACID SKID		23-HV-301, 302, 303-A/B, 304-A/B	VEOLIA
CITRIC ACID CHEM AREA	CITRIC ACID FEED PUMP SKID	1	CHECK VALVE	2	CITRIC ACID SKID		23-CV-305-A/B	VEOLIA
CITRIC ACID CHEM AREA	CITRIC ACID FEED PUMP SKID	1	BALL VALVE	3	CITRIC ACID SKID		23-HV-307-A/B, 23-FV-305	VEOLIA
CITRIC ACID CHEM AREA	CITRIC ACID FEED PUMP SKID	1	DIAPHRAGM VALVE	2	CITRIC ACID SKID		23-HCV-305, 306	VEOLIA
CITRIC ACID CHEM AREA	CITRIC ACID FEED PUMP SKID	1 1/2	PRESSURE SAFETY VALVE	1	CITRIC ACID SKID		23-PSV-301	CONTRACTOR
C-540, 541, VEOLIA P&IDs								
MEMBRANE ZONE	MEMBRANE ZONE 1,2,3,4	10	BUTTERFLY VALVE	4	LUG	PNEUMATIC	20-FV-205-1/2/3/4	VEOLIA
MEMBRANE ZONE	MEMBRANE ZONE 1,2,3,4	8	BUTTERFLY VALVE	24	LUG	MANUAL	20-HV-310-A/B/C/D/E/F-X	VEOLIA
MEMBRANE ZONE	MEMBRANE ZONE 1,2,3,4	3	BUTTERFLY VALVE	24	LUG	MANUAL	20-HV-204-A/B/C/D/E/F-X	VEOLIA
MEMBRANE ZONE	AIR SUPPLY ASSEMBLY ZONE 1,2,3,4	1/4	BALL VALVE	4	MEMBRANE TANK EJECTOR ASSEMBLY		20-HV-802-1/2/3/4	VEOLIA
MEMBRANE ZONE	AIR SUPPLY ASSEMBLY ZONE 1,2,3,4	1/4	PRESSURE REDUCING GATE VALVE	4	MEMBRANE TANK EJECTOR ASSEMBLY		20-PCV-801-1/2/3/4	VEOLIA
MEMBRANE ZONE	AIR SUPPLY ASSEMBLY ZONE 1,2,3,4	1/4	GATE VALVE	4	MEMBRANE TANK EJECTOR ASSEMBLY		20-FV-802-1/2/3/4	VEOLIA
MEMBRANE ZONE	EJECTOR ASSEMBLY	1	ANGLE VALVE	4	MEMBRANE TANK EJECTOR ASSEMBLY		20-FV-801-1/2/3/4	VEOLIA
MEMBRANE ZONE	EJECTOR ASSEMBLY	1	BALL VALVE	4	MEMBRANE TANK EJECTOR ASSEMBLY		20-HV-801-1/2/3/4	VEOLIA

MEMBRANE ZONE	EJECTOR ASSEMBLY	1/2	BALL VALVE	4	MEMBRANE TANK EJECTOR ASSEMBLY		20-HV-803-1/2/3/4	VEOLIA
C- 550, 551, VEOLIA P&IDs								
R.A.S.PUMP ROOM	R.A.S./W.A.S./DRAIN PUMP	20	KNIFE GATE VALVE	4	NPT	PNEUMATIC	20-FV-502-1/2/3/4	VEOLIA
R.A.S.PUMP ROOM	R.A.S./W.A.S./DRAIN PUMP	1	BALL VALVE	16	NPT	MANUAL	20-HV-503, 504, 505, 506-1/2/3/4	VEOLIA
R.A.S.PUMP ROOM	R.A.S./W.A.S./DRAIN PUMP	18	CHECK VALVE	4	FLANGED	MANUAL	20-CV-501-1/2/3/4	VEOLIA
R.A.S.PUMP ROOM	R.A.S./W.A.S./DRAIN PUMP	18	KNIFE GATE VALVE	4	LUG	MANUAL	20-HV-501-1/2/3/4	VEOLIA
R.A.S.PUMP ROOM	R.A.S./W.A.S./DRAIN PUMP	16	BUTTERFLY VALVE	4	LUG	PNEUMATIC	20-FV-622-1/2/3/4	VEOLIA
R.A.S.PUMP ROOM	R.A.S./W.A.S./DRAIN PUMP	2	BALL VALVE	4	NPT	MANUAL	20-HV-305-1/2/3/4	VEOLIA
R.A.S.PUMP ROOM	R.A.S./W.A.S./DRAIN PUMP	1	BALL VALVE	4	TRUE UNION	PNEUMATIC	20-FV-803-1/2/3/4	VEOLIA
R.A.S.PUMP ROOM	R.A.S./W.A.S./DRAIN PUMP	3/8	BALL VALVE	4	NPT	MANUAL	20-HV-321-1/2/3/4	VEOLIA
R.A.S.PUMP ROOM	R.A.S./W.A.S./DRAIN PUMP	1/2	BALL VALVE	4	NPT	MANUAL	20-HV-302-1/2/3/4	VEOLIA
R.A.S.PUMP ROOM	R.A.S./W.A.S./DRAIN PUMP	16	V-PORT BALL VALVE	4	FLANGED	PNEUMATIC	20-FCV-301-1/2/3/4	VEOLIA
R.A.S.PUMP ROOM	R.A.S./W.A.S./DRAIN PUMP	1/2	BALL VALVE	4	NPT	MANUAL	20-HV-301-1/2/3/4	VEOLIA
R.A.S.PUMP ROOM	R.A.S./W.A.S./DRAIN PUMP	3/8	BALL VALVE	4	NPT	MANUAL	20-HV-320-1/2/3/4	VEOLIA
R.A.S.PUMP ROOM	R.A.S./W.A.S./DRAIN PUMP	4	BALL VALVE	4	LUG	MANUAL	20-HV-304-1/2/3/4	VEOLIA
R.A.S.PUMP ROOM	R.A.S./W.A.S./DRAIN PUMP	16	BALL VALVE	4	LUG	MANUAL	20-HV-303-1/2/3/4	VEOLIA
C-550, 551, VEOLIA P&IDs								
R.A.S. PUMP ROOM	R.A.S. DISCHARGE HEADER	36	KNIFE GATE VALVE	1	FLANGED	PNEUMATIC	16-FV-510	VEOLIA
C-551, VEOLIA P&IDs								
R.A.S.PUMP ROOM	W.A.S. LINE	4	KNIFE GATE VALVE	1	LUG	MANUAL	16-HV-705	VEOLIA
R.A.S. PUMP ROOM	W.A.S. LINE	4	KNIFE GATE VALVE	1	NPT	PNEUMATIC	16-FV-700	VEOLIA
R.A.S.PUMP ROOM	W.A.S. LINE	4	DIAPHRAGM VALVE	1	FLANGED	MANUAL	16-HV-700	VEOLIA
R.A.S.PUMP ROOM	W.A.S. LINE	4	BALL CHECK VALVE FLYGT5087	1	FLANGED	N/A	5-CV-6	CONTRACTOR
C-550, 551, VEOLIA P&IDs								
R.A.S PUMP ROOM	TURBIDITY METER	1/4	SOLENOID VALVE	8	TURBIDITY ASSEMBLY		20-FV-320,324-1/2/3/4	VEOLIA
R.A.S PUMP ROOM	TURBIDITY METER	1/4	NEEDLE VALVE	8	TURBIDITY ASSEMBLY		20-HCV-320,324-1/2/3/4	VEOLIA
C-550, 551, VEOLIA P&IDs								
R.A.S. PUMP ROOM	PERMEATE SIPHONS/30" HEADER	1/4	BALL VALVE	3	PERMEATE EJECTOR ASSEMBLY		20-HV-802-5/6/7	VEOLIA
R.A.S. PUMP ROOM	PERMEATE SIPHONS/30" HEADER	1/4	PRESSURE REDUCING GATE VALVE	3	PERMEATE EJECTOR ASSEMBLY		20-PCV-801-5/6/7	VEOLIA
R.A.S. PUMP ROOM	PERMEATE SIPHONS/30" HEADER	1/4	GATE VALVE	3	PERMEATE EJECTOR ASSEMBLY		20-FV-802-5/6/7	VEOLIA
R.A.S. PUMP ROOM	PERMEATE SIPHONS/30" HEADER	1	ANGLE VALVE	3	PERMEATE EJECTOR ASSEMBLY		20-FV-801-5/6/7	VEOLIA
R.A.S. PUMP ROOM	PERMEATE SIPHONS/30" HEADER	1	BALL VALVE	3	PERMEATE EJECTOR ASSEMBLY		20-HV-801-5/6/7	VEOLIA
R.A.S. PUMP ROOM	PERMEATE SIPHONS/30" HEADER	1/2	BALL VALVE	3	PERMEATE EJECTOR ASSEMBLY		20-HV-803-5/6/7	VEOLIA
C-553								
CHEMICAL FILL STATION	FILL STATION CATCH BASIN DISCHARGE PIPE	6	GATE VALVE	1	FLANGED	MANUAL	5-RWGV-14	CONTRACTOR
C-550								
OUTSIDE MBR BUILDING	TEMPORARY AND PERMANENT W.A.S. LINE	4	PLUG VALVE	2	FLANGED	MANUAL	5-PV-1/2	CONTRACTOR
C-542								
LAYDOWN AREA	MBR DRAIN PUMP STATION	3	BALL VALVE	2	UNION	MANUAL	5-BV-6/7	CONTRACTOR
LAYDOWN AREA	MBR DRAIN PUMP STATION	3	CHECK VALVE	2	UNION	MANUAL	5-CV-7/8	CONTRACTOR
C-552, VEOLIA P&IDs								
BLOWER ROOM	MEMBRANE BLOWERS 1,2,3,4,5	1/2	BALL VALVE	5	MEMBRANE BLOWER ASSEMBLY		20-HV-203-A/B/C/D/E	VEOLIA
BLOWER ROOM	MEMBRANE BLOWERS 1,2,3,4,5	6	CHECK VALVE	5	MEMBRANE BLOWER ASSEMBLY		20-CV-201-A/B/C/D/E	VEOLIA
BLOWER ROOM	MEMBRANE BLOWERS 1,2,3,4,5	8	BUTTERFLY VALVE	5	LUG	MANUAL	20-HV-201-A/B/C/D/E	VEOLIA
C-552, VEOLIA P&IDs								
BLOWER ROOM	PROCESS BLOWERS 1,2,3	10	BUTTERFLY VALVE	3	LUG	GEAR	16-HV-400-A/B/C	VEOLIA
BLOWER ROOM	PROCESS BLOWERS 1,2,3	1/2	BALL VALVE	3	PROCESS BLOWER ASSEMBLY		16-HV-403-A/B/C	VEOLIA
BLOWER ROOM	PROCESS BLOWERS 1,2,3	3	CHECK VALVE	3	PROCESS BLOWER ASSEMBLY		16-CV-401-A/B/C	VEOLIA
BLOWER ROOM	PROCESS BLOWERS 1,2,3	10	BUTTERFLY VALVE	3	LUG	GEAR	16-HV-401-A/B/C	VEOLIA
C-553, VEOLIA P&IDs								
MECHANICAL ROOM	AIR COMPRESSOR 1,2		PRESSURE SAFETY ANGLE VALVE	2	AIR COMPRESSOR		90-PSV-001-A/B	VEOLIA
MECHANICAL ROOM	AIR COMPRESSOR 1,2		SOLENOID VALVE	2	AIR COMPRESSOR		90-FV-001-A/B	VEOLIA

MECHANICAL ROOM	AIR COMPRESSOR 1,2	1	BALL VALVE	2	AIR COMPRESSOR		90-HV-001-A/B	VEOLIA
C-553, VEOLIA P&IDs								
MECHANICAL ROOM	REFRIGERATED AIR DRYER	3/4	BALL VALVE	4	NPT	MANUAL	90-HV-002,003-A/B	VEOLIA
MECHANICAL ROOM	REFRIGERATED AIR DRYER	3/8	BALL VALVE	2	BARB	MANUAL		CONTRACTOR
C-553, VEOLIA P&IDs								
MECHANICAL ROOM	MAIN AIR COMPONENT KIT	1/2	GATE VALVE	1	AIR COMPRESSOR INSTRUMENT		90-HV-004	VEOLIA
MECHANICAL ROOM	MAIN AIR COMPONENT KIT	1/2	BALL VALVE	2	AIR COMPRESSOR INSTRUMENT		90-HV-005,006	VEOLIA
MECHANICAL ROOM	MAIN AIR COMPONENT KIT	1/8	PRESSURE REDUCING DIAPHRAGM	1	AIR COMPRESSOR INSTRUMENT		90-PCV-001	VEOLIA
C-553, VEOLIA P&IDs								
MECHANICAL ROOM	MAIN AIR COMPONENT KIT	1	TIMED DRAIN VALVE WITH SOLENOID	4	NPT	ELECTRIC	90-FV-011-A/B/C/D	CONTRACTOR
MECHANICAL ROOM	MAIN AIR COMPONENT KIT	1	BALL VALVE	26	NPT	MANUAL	90-HV-1/2/…25/26	CONTRACTOR
C-553								
MBR CHEMICAL FILL STATION	SODIUM HYPOCHLORITE CHEMICAL FILL STATION	2	SCH80 PVC BALL VALVE	1	FLANGED	MANUAL	5-BV-8	CONTRACTOR
MBR CHEMICAL FILL STATION	SODIUM HYDROXIDE CHEMICAL FILL STATION	2	SCH80 PVC BALL VALVE	2	FLANGED	MANUAL	5-BV-9/10	CONTRACTOR
C-553								
STORAGE ROOM 1	SODIUM HYPOCHLORITE FILL STATION TO STORAGE TANK 1	2	SCH80 PVC ISOLATION BALL VALVE	1	FLANGED	MANUAL	5-BV-11	CONTRACTOR
STORAGE ROOM 2 AND 3	SODIUM HYDROXIDE FILL STATION TO STORAGE TANK 2 AND 3	2	SCH80 PVC ISOLATION BALL VALVE	2	FLANGED	MANUAL	5-BV-12/13	CONTRACTOR
C-553								
CHEM FEED ROOM	SODIUM HYPOCHLORITE STORAGE TANK 1 TO TRANSFER PUMP	2	SCH80 PVC BALL VALVE	1	FLANGED	MANUAL	5-BV-14	CONTRACTOR
CHEM FEED ROOM	SODIUM HYDROXIDE STORAGE TANKS 2 AND 3 TO TRANSFER PUMP	2	SCH80 PVC BALL VALVE	2	FLANGED	MANUAL	5-BV-15/16	CONTRACTOR
C-553								
CHEM FEED ROOM	TRANSFER PUMP TO SODIUM HYPOCHLORITE DAY TANK	2	SCH80 PVC BALL VALVE	1	FLANGED	MANUAL	5-BV-17	CONTRACTOR
CHEM FEED ROOM	TRANSFER PUMP TO SODIUM HYDROXIDE DAY TANK	2	SCH80 PVC BALL VALVE	2	FLANGED	MANUAL	5-BV-18/19	CONTRACTOR
C-553, VEOLIA P&IDs								
CHEM FEED ROOM	SODIIUM HYDROXIDE INJECTION SYSTEM	1 1/2	PRESSURE SAFETY VALVE	2	SODIUM HYDROXIDE SKID		15-PSV-310-1, 320	VEOLIA
CHEM FEED ROOM	SODIIUM HYDROXIDE INJECTION SYSTEM	1 1/2	BALL VALVE	10	SODIUM HYDROXIDE SKID		15-HV-300, 301, 302, 310, 311, 312, 313, 320, 321, 322, 323	VEOLIA
C-553, VEOLIA P&IDs								
CHEM FEED ROOM	SODIUM HYPOCHLORITE FEED PUMP SKID	1 .5	BALL VALVE	3	SODIUM HYPOCHLORITE SKID		23-HV-108, 106-A/B	VEOLIA
CHEM FEED ROOM	SODIUM HYPOCHLORITE FEED PUMP SKID	1 1/2	BALL VALVE	6	SODIUM HYPOCHLORITE SKID		23-HV-101, 102, 103-A/B, 104-A/B	VEOLIA
CHEM FEED ROOM	SODIUM HYPOCHLORITE FEED PUMP SKID	1	CHECK VALVE	2	SODIUM HYPOCHLORITE SKID		23-CV-105-A/B	VEOLIA
CHEM FEED ROOM	SODIUM HYPOCHLORITE FEED PUMP SKID	1	BALL VALVE	3	SODIUM HYPOCHLORITE SKID		23-HV-107-A/B, 23-FV-105	VEOLIA
CHEM FEED ROOM	SODIUM HYPOCHLORITE FEED PUMP SKID	1	DIAPHRAGM VALVE	2	SODIUM HYPOCHLORITE SKID		23-HCV-105, 106	VEOLIA
CHEM FEED ROOM	SODIUM HYPOCHLORITE FEED PUMP SKID	1 1/2	PRESSURE SAFETY VALVE	1	SODIUM HYPOCHLORITE SKID		23-PSV-101	CONTRACTOR
C-554, VEOLIA P&IDs								
R.A.S. PUMP ROOM	BACKPULSE LINE	16	BUTTERFLY VALVE	4	LUG	PNEUMATIC	20-FV-621-1/2/3/4	VEOLIA
R.A.S. PUMP ROOM	BACKPULSE LINE	1/2	BALL VALVE	1	NPT	MANUAL	20-HV-602	VEOLIA
R.A.S. PUMP ROOM	BACKPULSE LINE	2	BALL VALVE	1	NPT	MANUAL	20-HV-600	VEOLIA
C-554, VEOLIA P&IDs								
R.A.S. PUMP ROOM	SODIUM HYDROXIDE TO CHEM. INJECTION	1 1/2	BACKPRESSURE CONTROL VALVE	1	SODIUM HYDROXIDE SKID		15-PCV-301	VEOLIA
C-554, VEOLIA P&IDs								
R.A.S. PUMP ROOM	CITRIC ACID FEED	1/2	BALL VALVE	1	TRUE UNION	PNEUMATIC	23-FV-330	VEOLIA
R.A.S. PUMP ROOM	CITRIC ACID FEED	1/2	BALL VALVE	1	TRUE UNION	MANUAL	23-HV-330	VEOLIA
R.A.S. PUMP ROOM	CITRIC ACID FEED	1/2	CHECK VALVE	1	TRUE UNION	MANUAL	23-CV-330	VEOLIA
C-554, VEOLIA P&IDs								
R.A.S. PUMP ROOM	SODIUM HYPOCHLORITE FEED	1	BALL VALVE	1	TRUE UNION	PNEUMATIC	23-FV-130	VEOLIA
R.A.S. PUMP ROOM	SODIUM HYPOCHLORITE FEED	1	BALL VALVE	1	TRUE UNION	MANUAL	23-HV-130	VEOLIA
R.A.S. PUMP ROOM	SODIUM HYPOCHLORITE FEED	1	CHECK VALVE	1	TRUE UNION	MANUAL	23-CV-130	VEOLIA
C-554, 555								
R.A.S. PUMP ROOM	PERMEATE AIR EJECTOR ASSEMBLY	4	BALL VALVE	1	FLANGED	MANUAL	5-BV-20	CONTRACTOR

C-600s								
C-602								
CHLOR DECHLOR BASIN	BLOWER 1 AND 2 AIR LINES	4	BUTTERFLY VALVE	2	FLANGED	MANUAL	6-BFV-1/2	CONTRACTOR
C-602/604								
CHLOR DECHLOR BASIN	COOLAER PUMPS DISCHARGETO ATAD	4	RESILIENT WEDGE GATE VALVE	2	FLANGED	MANUAL	6-RWGV-1/2	CONTRACTOR
CHLOR DECHLOR BASIN	COOLAER PUMPS FOR ATAD	4	CHECK VALVE	2	FLANGED	MANUAL	6-CV-1/2	CONTRACTOR
CHLOR DECHLOR BASIN	PLANT WATER SUCTION LINES	8	RESILIENT WEDGE GATE VALVE	2	FLANGED	MANUAL	6-RWGV-3/4	CONTRACTOR
CHLOR DECHLOR BASIN	COOLAER RETURN FOR ATAD	6	RESILIENT WEDGE GATE VALVE	6	FLANGED	MANUAL	6-RWGV-5	CONTRACTOR
C-603								
BLOWER PLATFORM	BLOWER TO AIR SUPPLY HEADER	4	BUTTERFLY VALVE	4	FLANGED	MANUAL	6-BFV-3/4/5/6	CONTRACTOR
C-604, VEOLIA P&IDs								
BACKPULSE PUMP VALVE VAULT	BACKPULSE PUMP 1 AND 2	16	BUTTERFLY VALVE	2	FLANGED	MANUAL	20-HV-610-1/2	VEOLIA
BACKPULSE PUMP VALVE VAULT	BACKPULSE PUMP 1 AND 2	16	CHECK VALVE	2	FLANGED	MANUAL	20-CV-602-1/2	VEOLIA
C-604, PPS P&IDs								
PLANT WATER BOOSTER PUMP STATION	PLANT WATER PUMP	3/4	AIR RELIEF VALVE	3	BOOSTER PUMP STATION ASSEMBLY		6-ARV-1/2/3	MANUFACTURER
PLANT WATER BOOSTER PUMP STATION	PLANT WATER PUMP	2	BUTTERFLY VALVE	1	BOOSTER PUMP STATION ASSEMBLY		6-BFV-7	MANUFACTURER
PLANT WATER BOOSTER PUMP STATION	PLANT WATER PUMP	6	BUTTERFLY VALVE	6	BOOSTER PUMP STATION ASSEMBLY		6-BFV-8/9/10/11/12/13	MANUFACTURER
PLANT WATER BOOSTER PUMP STATION	PLANT WATER PUMP	2	ANGLED PRESSURE RELIEF VALVE	1	BOOSTER PUMP STATION ASSEMBLY		6-APRV-1	MANUFACTURER
PLANT WATER BOOSTER PUMP STATION	PLANT WATER PUMP	1	ICV VALVE	1	BOOSTER PUMP STATION ASSEMBLY		6-ICV-1	MANUFACTURER
PLANT WATER BOOSTER PUMP STATION	PLANT WATER PUMP	6	CHECK VALVE	2	BOOSTER PUMP STATION ASSEMBLY		6-CV-3/4	MANUFACTURER

C-700s								
C-702								
DEWATERING BUILDING	PLANT WATER BOOSTER PUMP CONNECTION	1 1/2	PVC BALL VALVE	3	TRUE UNION	MANUAL	7-BV-1/2/3	CONTRACTOR
C-704								
DEWATERING BUILDING EXISTING SUMP PIT	SUMP PUMP	4	CHECK VALVE	2	FLANGED	MANUAL	7-CV-1/2	CONTRACTOR
DEWATERING BUILDING EXISTING SUMP PIT	SUMP PUMP	4	PLUG VALVE	2	FLANGED	MANUAL	7-PV-1/2	CONTRACTOR

*VALVE SCHEDULE EXCLUDES MISCELLANEOUS SITE PIPING VALVES SHOWN ON THE C-100S SITE PLANS. CONTRACTOR RESPONIBLE TO VERIFY ALL VALVES REQUIRED AS SHOWN ON THE PLANS.VALVE SCHEDULE PROVIDED FOR CONTRACTORS REFERENCE ONLY.

** ATAD SUPPLIED EQUIPMENT TO BE PROCURED BY CONTRACTOR. VEOLIA CONTRACT TO BE ASSUMED BY CONTRACTOR.

PROCESS VALVES

2.3 FABRICATION:

A. End Connections:
   1. Provide the type of end connections for valves as required in the Piping Schedules as shown on the Drawings or specified in Division 40.
   2. Comply with the following standards:
      a. Threaded: ASME B1.20.1.
      b. Flanged: ASME B16.1, Class 125 unless otherwise noted or AWWA C207.
      c. Bell and spigot or mechanical (gland) type: AWWA/ANSI C111/A21.11.
      d. Soldered: ASME B16.18.
      e. Grooved: Rigid joints per Table 5 of AWWA C606.

B. Refer to individual valve Specification Sections for respective supplemental requirements for each type of valve used.

C. Nuts, Bolts, and Washers:

   1. Wetted or internal to be bronze or stainless steel.
   2. Exposed to be zinc or cadmium plated.

D. On Insulated Piping: Provide valves with extended stems to permit proper insulation application without interference from handle.

E. Epoxy Interior Coating: Provide epoxy interior coating for all ferrous surfaces in accordance with AWWA C550.

2.4 ACTUATORS:

Refer to SECTION 400557 for more information regarding ACTUATORS FOR PROCESS VALVES AND GATES.

2.5 BALL VALVES:

A. Ball valves shall be model RF15 series as manufactured by Bray or approved equal.

B. Valve size shall match line size.

C. Body material shall be coated carbon steel.

D. Flanges shall be ANSI Class 150.

E. Seats shall be Tek-Fil or as recommended by the manufacturer for potable water service at the pressure rating of the flanged connections.

F. Face to face dimensions shall meet ASME B16.10 short pattern.

G. Manual actuation on all valves.

2.6 BALL VALVES (PVC, CPVC, PP AND PVDF)

A. All requirements are for PVC, CPVC, PP, PVDF Type 21/21a ball valves and accessories

B. U-PVC – Conforming to ASTM D1784 Cell Classification 12454 AAll Type-21/21a ball valves sized ½" – 6" shall be of True-Union design with 2-way blocking capability. PTFE seats shall have elastomeric backing cushions to provide smooth even stem torque and to compensate for wear. Valves shall feature molded ISO mounting top flange for actuation installation and Panel Mount feature on bottom of valve for securing in-line. The handle shall double as the spanner wrench for maintenance and carrier adjustment.

C. Type-21/21a 1/2" – 6" (Lever Type standard) Lever Handle to be Asahi Standard valve handle Red color

D. Type-21/21a Ball Valves shall be provided by Asahi/America, Inc. of Lawrence, MA with no approved equals. Manufacturer must be ISO-9001 certified.

E. Valves shall have a pressure rating of: 230 psi at 700 F sizes 1/2" – 3" PVC, CPVC, PVDF (Socket, Thread or Butt) 150 psi at 700 F sizes 1/2" – 6" PP, 4 – 6" PVC, CPVC, & PVDF 150 psi at 700 F sizes 1/2" – 6" PVC, CPVC, PP & PVDF (Flanged)

F. Stem extensions where required should be designed, built and provided by the Asahi/America, Inc., and be 1 of 4 styles:

1. Style: BV-A Two piece extension with outer housing 100% sealed either free standing or supported design.
2. Style: BV-B Single piece extension either free standing or supported design
3. Style: BV-P Single piece Panel Mount Extension made of PVC Minimum Length = 4" Maximum Length = 12" Not Available for 4" or 6" Valves
4. Style: T21 Stem Extension Ends Kit. These are factory machined kits that permit the installer to fabricate PVC stem extensions using Schedule 40 or 80 PVC pipe. Max length 6 feet.

2.7 BALL CHECK VALVES:

A. Ball check valves shall be Model 5087 as manufactured by Flygt.

B. Valve size shall match line size.

C. Body material shall be Nodular Cast Iron Type GGG40/ASTM 65-45-12/SAE D4512

D. Flange drilling ANSI B16.1 Class 125 Flat Faced Bolt holes straddle centerline.

E. Ball shall be metal corewith vulcanized nitrile rubber covering. Sinking Type specific gravity greater than 1.0. Floating Type specific gravity less than 1.0.

F. Working Pressure shall be 145 psi max.

G. Working temperature shall be 176 degrees Fahrenheit max. (212 degreed Fahrenheit max with optional EPDM-coated ball).

B. Refer to SECTION 400565 for more information regarding BALL CHECK VALVES

2.8 BUTTERFLY VALVES:

A. Valves, actuators, and positioners shall be provided by DeZurik, Clow, Kennedy, or acceptable equal.

B. Valves provided shall be specifically designed for waste water service of the type and character required at the F.C.I. Otisville Facility.

C. All valves shall meet the requirements of AWWA C-504-87.

D. Valves shall be designed to operate at a 200-psi maximum pressure and a temperature range of -40 to 160 degrees Fahrenheit.

E. Valves shall provide drip-tight shutoff at differentials of up to 200 psi.

F. Refer to SECTION 331216.03 for more information regarding BUTTERFLY VALVES

2.9 BUTTERFLY VALVES AIR SERVICE:

A. Valves, actuators, and positioners shall be provided by DeZurik, Clow, Kennedy, or acceptable equal.

B. Valves provided shall be specifically designed for air service of the type and character required at the F.C.I. Otisville Facility.

C. Valves shall be designed to operate at a 50 psi maximum pressure and a temperature range of -40 to 160 degrees Fahrenheit.

D. Valves shall provide drip-tight shutoff at differentials up to 50 psi.

E. Refer to SECTION 331216.02 for more information regarding BUTTERFLY VALVES for AIR SERVICE

2.10 PLUG VALVES:

A. Shall be manufactured by Val-Matic, DeZurik or an acceptable equal.

B. Shall turn ninety degrees (90B) to open and have a square operating nut.

C. The ends shall be push-on or mechanical joint with adapters for outside installations, at the Contractor's option. Inside installations shall be flanged.

D. Valve port area shall not be less than the full pipe area and comply with ASME/ANSI B36.10M.

E. Body material shall be ductile iron meeting ASTM A 536 Grade 65-45-12 standards.

F. Flanges shall be ANSI Class 150.

G. Interior and exterior of the valve shall be coated with an ANSI/NSF fusion bonded epoxy coating.

H. Valves in the treatment building shall be equipped with an electric actuator or manual worm gear actuator as indicated on the Contact Drawings.

I. Valves in the Interconnection Vaults (Union Drive and Express Drive) shall be equipped with an operating nut and equipped with a cast iron valve box as shown on the Contract Drawings. Valve box shall be by General Foundry or equal.

J. Refer to SECTION 335133.10 for more information regarding PLUG VALVES.

2.11 GATE VALVES:

A. Shall be "Ken-Seal" as manufactured by ITT Kennedy Valve, or acceptable equal.

B. Shall conform to AWWA C509 "year of latest revision".

C. Shall turn to open in the direction similar to the existing municipal valves and have a rustproof steel, hex-shaped operating nut.

D. The ends shall be flanged or mechanical joint with adapters at the Contractor's option, unless a specific valve body is indicated on the plans.

E. Valves shall be non-rising stem, unless otherwise noted.

F. Refer to SECTION 331216.01.S for more information regarding RESILIENT-DISC GATE VALVE

2.12 KNIFE GATE VALVES:

A. Shall be Valves, actuators, and positioners shall be provided by DeZurik, Clow, Kennedy, or acceptable equal.

B. Knife Gate Valve shall be bonnetless, Urethane Lined, Bi-Directional Cast Knife Gate

C. Refer to SECTION 4000561.43 for more information regarding Knife Gate Valves.

2.13 MUD VALVES

A. The Mud Valve shall be of the heavy duty flanged type designed to provide a positive seal. The

valves shall be (non-rising, rising) stem style as detailed on the schedule or the plans. The frame, plug, operating stem, and yoke shall be stainless steel. The plug seat shall be Buna-N or Viton rubber for a positive seal.

B. Stems shall not be coated as coatings can wear off and eventually lead to galling

C. Valve stem shall be rolled and not cast as rolled threads provide more durability and strength.

D. Plug stem shall have hydraulic relief slots to prevent sediment from building up in the plug stem area.

E. Plug base shall have no thru holes to prevent any possible leak path

F. The valve shall be machined, assembled, and tested in the USA for quality assurance.

G. The manufacturer shall show proof of ISO 9001 certification.

H. Where required, the manufacturer shall provide valve operating stems, floor stands, and stem guides as specified in the valve schedule or plans.

I. Valve and accessories shall be manufactured by Troy Valve Model MVXN (nonrising) or MVXR (rising) or approved equal.

PART 3 – EXECUTION

3.1 INSTALLATION:

A. Flanged valves shall have bolt holes that straddle the pipe centerline. Clean flange faces, insert gasket and bolts, and tighten nuts progressively and uniformly.

B. Screwed valves shall have the threads cleaned, burrs removed, and joint compound applied.

C. Valve Orientation:

1. Install operating stem vertical when valve is installed in horizontal runs of pipe having centerline elevations 4’6” or less above finished floor, unless otherwise shown.

2. Install operating stem horizontal in horizontal runs of pipe having centerline elevations between 4’6” and 6’9” above finish floor, unless otherwise shown.

3. Orient butterfly valve shaft so that unbalanced flows or eddies are equally divided to each half of the disc, i.e., shaft is in the plane of rotation of the eddy.

4. If no plug valve seat position is shown, locate as follows:

a. Horizontal Flow: The flow shall produce an “unseating” pressure, and the plug shall open into the top half of valve.
b. Vertical Flow: Install seat in the highest portion of the valve.

D. Install a line size ball valve and union upstream of each solenoid valve, in-line flow switch, or other in-line electrical device, excluding magnetic flow meters, for isolation during maintenance.

E. Locate valve to provide accessibility for control and maintenance. Install access doors in finished walls and plaster ceilings for valve access.

F. Extension Stem for Operator: Where the depth of the valve is such that its centerline is more than 3 feet below grade. Furnish an operating extension stem with 2" operating nut to bring the operating nut to a point 6" below the surface of the ground and/or box cover.

G. Torque Tube: Where operator for quarter-turn valve is located on floor stand. Furnish extension stem torque tube of a type properly sized for maximum torque capacity of the valve.

H. Floor Box and Stem: Steel extension stem length shall locate operating nut in floor box.

I. Install products in accordance with manufacturer's instructions.

J. Painting Requirements: Comply with Division 09 "High Performance Coatings" semi-gloss severe service requirements for painting and protective coatings.

K. Support exposed valves and piping adjacent to valves independently to eliminate pipe loads being transferred to valve and valve loads being transferred to the piping.

L. For grooved coupling valves, install rigid type couplings or provide separate support to prevent rotation of valve from installed position.

M. Install electric or cylinder actuators above or horizontally adjacent to valve and gear box to optimize access to controls and external handwheel.

N. For threaded valves, provide union on 1 side within 2 FT of valve to allow valve removal.

O. Install valves accessible for operation, inspection, and maintenance

3.2 TESTS AND INSPECTION

A. Valve may be either tested while testing pipelines, or as a separate step.

B. Test that valves open and close smoothly with operating pressure on one side and atmospheric pressure on the other, in both directions for two-way valve and applications.

C. Inspect air and vacuum valves as pipe is being filled to verify venting and seating is fully functional.

D. Count and record number of turns to open and close valve; account for any discrepancies with Manufacturer's data.

E. Set, verify, and record set pressures for all relief and regulating valves.

F. Automatic valve to be tested in conjunction with control system testing.

G. Test hydrostatic relief valve seating; record leakage. Adjust and retest to maximum leakage of 0.1 gpm per foot of seat periphery.

END OF SECTION 400552

SECTION 400557 – ACTUATORS FOR PROCESS VALVES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Contractor shall furnish all labor, materials, tools and equipment as necessary to install process valves of the type, and at locations shown in the Contract Plans. Individual Division 40 valve specifications may have supplemental requirements.

B. Contractor shall furnish all labor, materials, tools and equipment as necessary to install process valve actuators and appurtenances.

C. Division 22, 23, and 46 valves have differing requirements that are specified in those respective divisions. This Section shall not apply to the valves specified in those Divisions.

1.3 RELATED SECTIONS

A. Division 09 Section “High Performance Coatings”.

B. Division 26 Sections for electrical requirements to power actuators.

C. Division 40 Section “Process Valves” with attached Schedule

1.4 DEFINITIONS

A. The following are industry abbreviations for materials:
   1. HDPE: High-density Polyethylene.
   2. PVC: Polyvinyl Chloride.
   3. DIP: Ductile Iron Pipe.

1.5 REFERENCE STANDARDS

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. D256, Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
      b. D638, Standard Test Method for Tensile Properties of Plastics.
      c. D648, Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
      d. D695, Standard Test Method for Compressive Properties of Rigid Plastics.
      e. D2240, Standard Test Method for Rubber Property-Durometer Hardness.

   2. American Water Works Association (AWWA):
      a. C500, Standard for Metal-Seated Gate Valves for Water Supply Service.
      b. C504, Standard for Rubber-Seated Butterfly Valves.

      c. C507, Standard for Ball Valves, 6 IN through 48 IN (150 MM through 1,200

MM).
d. C509, Standard for Resilient-Seated Gate Valves for Water Supply Service.
e. C541, Standard for Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates.
f. C542, Standard for Electric Motor Actuators for Valves and Slide Gates.
g. C550, Standard for Protective Coatings for Valves and Hydrants.

3. American Water Works Association/American National Standards Institute (AWWA/ANSI):
a. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

4. National Electrical Manufacturers Association (NEMA):
a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
b. MG 1, Motors and Generators.

1.6 SUBMITTALS

A. All iron and steel products used in the Work must be produced in the United States and certifications of such production must be provided to the Owner prior to installation.

B. Shop Drawings:
1. Product technical data including:
a. Manufacturer's installation instructions.
b. Wiring and control diagrams for electric or cylinder actuators.

2. Test reports.

C. Operation and Maintenance Manuals.

D. Informational Submittals: Verification from valve actuator manufacturer that actuators have been installed properly, that all limit switches and position potentiometers have been properly adjusted, and that the valve actuator responds correctly to the valve position command.

1.7 QUALITY ASSURANCE

A. Valve manufacturers shall have a minimum of ten (10) years experience in the manufacture of the type of actuator to be provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers listed below are considered basis of design manufacturers. Acceptable equals are allowed.
1. Electric Actuators: Remote Control Inc., North Kingstown, RI 02852. Ph: 401.294.1400. www.rciactuators.com.
2. Manual Actuators: As supplied by manual valve manufacturer.

2.2 ACTUATORS

A. General:
   1. Provide actuators as shown on Drawings or specified.
   2. Series RCEL. Models shall be selected by manufacturer based upon valve type, size, torque requirements, and required ancillaries as specified herein or as shown on the Contract Plans.
   3. All actuators shall have functionality to relay position to a central control panel for SCADA purposes.
   4. Counter clockwise opening as viewed from the top.
   5. Actuators shall be accessible and operable with 1.5” of insulation around the valves.
   6. Direction of opening and the word OPEN to be cast in handwheel or valve bonnet.
   7. Size actuator to produce required torque with a maximum pull of 80 LBS at the maximum pressure rating of the valve provided and withstands without damage a pull of 200 LBS on handwheel or chainwheel or 300 FT-LBS torque on the operating nut.
   8. Unless otherwise specified, actuators for valves to be buried, submerged or installed in vaults or manholes shall be sealed to withstand at least 20 FT of submergence.
   9. Extension stem:
      a. Install on all valves to allow for 1.5” insulation thickness.
      b. Solid steel with actuator key and nut, diameter not less than stem of valve actuator shaft.
      c. Pin all stem connections.
      d. Center in valve box or grating opening band with guide bushing.

B. Buried Valve Actuators:
   1. Provide screw or slide type adjustable cast iron valve box, 5 IN minimum diameter, 3/16 IN minimum thickness, and identifying cast iron cover rated for traffic load.
   2. Box base to enclose buried valve gear box or bonnet.
   3. Provide 2 IN standard actuator nuts complying with AWWA C500, Section 3.16.
   4. Provide at least 2 tee handle keys for actuator nuts, with 5 FT extension between key and handle.
   5. Extension stem:
      a. Provide for buried valves greater than 4 FT below finish grade.
      b. Extend to within 6 IN of finish grade.
   6. Provide concrete pad encasement of valve box as shown for all buried valves unless shown otherwise.

C. Exposed Valve Manual Actuators:
   1. Provide for all exposed valves not having electric or pneumatic actuators. Actuators shall be coated to prevent corrosion.
   2. Manufacturer to select size and type of manual actuators in accordance with AWWA C500 or as specified below.
   3. Provide lever actuators for plug valves, butterfly valves and ball valves 3 inch and smaller.
      a. Lever actuators for butterfly valves shall have a minimum of 5 intermediate lock positions between full open and full close.
      b. Provide at least 2 levers for each type and size of valve furnished.
   4. Gear actuators required for plug valves, butterfly valves, and ball valves 4 inch and larger.
   5. Provide gearing for gate valves 20 inch and larger in accordance with AWWA C500.
   6. Gear actuators to be totally enclosed, permanently lubricated and with sealed bearings.
   7. Provide chain actuators for valves 6 feet or higher from finished floor to valve centerline.
      a. Cadmium-plated chain looped to within 3 feet of finish floor.
      b. Equip chain wheels with chain guides to permit rapid operation with reasonable side pull without "gagging" the wheel.

8. Provide cast iron floor stands where shown on Drawings.
    a. Stands to be furnished by valve manufacturer with actuator.
    b. Stands or actuator to include thrust bearings for valve operation and weight of accessories.
    c. Stands shall be coated at the factory or shall be coated in the field per Division 09 "High Performance Coatings" requirements.

D. Submerged Actuators:
1. Mount the valve actuator on top of an extension bonnet 3 feet above any adjacent personnel access.
2. The valve and bonnet connection shall be flanged and watertight.
3. Provide a top brace support for the bonnet. Mount the brace 6 inch below the top of the wall as shown.
4. Materials:
    a. Extension bonnet: Cast iron ASTM A126 or steel.
    b. Brace and anchor bolts: Type 304 stainless steel.

E. Electric Actuators (480V, 3 PH):
1. Conform to AWWA C542.

2. Provide electric valve actuators with integral control devices and a remote pushbutton station.

3. Furnish electric actuator integral with valve consisting of:
    a. Motor.
    b. Gearing.
    c. Handwheel.
    d. Limit and torque switches.
    e. Lubricants.
    f. Heating elements.
    g. Wiring.
    h. Terminals for motor power and controls.
    i. Drive nut.

4. Housing/enclosure:
    a. Provide cast iron gear housing and cast iron load bearing enclosure.
    b. Non load bearing enclosure and housing: Aluminum or cast iron.
    c. Rated for area classification shown on Drawings.
    d. Provide O-ring seals for covers and entries.
    e. Terminal and limit switch compartment covers are to be fastened to gear housing by stainless steel fasteners with capture device to prevent loss.
5. Motors:
    a. Provide motors that are totally enclosed, high torque design made expressly for valve actuator service and capable of operating the valve under full differential pressure for complete open-close and reverse cycle of travel at least twice in immediate succession without overheating.
    b. Design motors in accordance with NEMA MG 1 standards, with Class B insulation, and to operate successfully at any voltage within 10 percent above or below rated voltage.
    c. Provide positive method to ensure motor bearings are permanently lubricated.
    d. Provide 3 thermal switches imbedded in windings:
        1) 120 degrees apart.
        2) Provide motor shutdown at high temperature.
    e. Motor housing:

1) Aluminum or cast iron.
2) Totally enclosed non-ventilated with cooling fins.

f. Provide motor capable of operating in any position.
g. Provide motor sealed from gear case to allow any mounting position.
h. Provide motors suitable for 480 V, 3 PH, 60 Hz.

6. Gearing:
   a. Provide power gearing consisting of heat treated steel helical gears, carburized and hardened alloy steel worm, and alloy bronze worm gear, all grease or oil bath lubricated, designed for 100 percent overload, and effectively sealed against entrance of foreign matter.
   b. Provide gearing mechanism constructed to permit field changes of reduction gear ratio.
   c. Design actuators so that motor comes up to speed before stem load is encountered in either opening or closing operation.
   d. Limit switch gearings and feedback device reduction gearing: Steel or bronze.
   e. Support rotating shafts with anti-friction bearings.
   f. Provide separate drive nut/thrust bearing assembly:
      1) Mounted to base of actuator.
      2) High tensile bronze.
      3) Quarter turn actuator: Provide 90 degree mounting intervals.
      4) Provide grease fitting on drive assembly.

7. Handwheel:
   a. Permanently attached for manual operation.
   b. Positive declutch mechanism to engage and disengage handwheel.
   c. Handwheel shall not rotate during motor operation.
   d. Inoperable motor shall not prevent manual operation.

8. Limit torque and thrust loads in both closing and opening directions by torque limit switches.
   a. Provide torque switches with micrometer adjustment and reference setting indicator.
   b. Assure adjustment variation of approximately 40 percent in torque setting.
   c. b. Provide switches having rating of not less than 6 A at 120 Vac and 2.2 A at 115 Vdc.
   d. Limit and torque switches shall have totally sealed contacts.

9. Furnish electric actuator with 2 geared limit switch assemblies with each switch assembly having 4 separate limit switches:
   a. Assure each limit switch assembly is geared to driving mechanism and is independently adjustable to trip at any point at and between the fully open and fully closed valve position.
   b. Provide minimum of 2 normally open contacts and 2 normally closed contacts at each end of valve travel.
   c. Provide switches with inductive contact rating of not less than 6 A at 120 Vac, 3 A at 240 Vac, 1.5 A at 480 Vac, 2.2 A at 115 Vdc and 1.1A at 230 Vdc.
   d. Limit switches shall be fully adjustable when power is applied to actuator.

10. Provide space heating elements sized to prevent condensation in both motor and geared limit switch compartment(s). Furnish heating elements rated at 120 Vac with heaters continuously energized.
11. Open-close actuator controls:

a. Provide control assembly with necessary holding relays, reversing starter, control transformers of sufficient capacity to provide control power, space heating element power and valve position transmitter.
b. Provide control assembly in an enclosure rated for the defined area classification.
c. Controls for open/close actuator:
1) Provide remote pushbutton station with enclosure rated for area classification shown on Drawings with:
a) Open pushbutton.
b) Close pushbutton.
c) Stop pushbutton.
d) Remote/local switch.
e) Full open light.
f) Full close light.
g) Open and close relays as required.
2) Provide control enclosure to accept: Remote open/close switches.
3) Provide contacts in control enclosure:
a) Remote/local contact.
b) Full open contact.
c) Full close contact.
d) Wire all components to an internal terminal strip and include mounted wiring diagram inside enclosure.

12. Additional requirements for modulating valve actuators:
a. Proportional position servo-amplifier mounted integral with the actuator control compartment.
b. Positioning of valve shall be proportional to a 4 to 20 mA signal input to the position servo-amplifier when remote control has been selected.
c. Servo-amplifier adjustments shall include zero, span, gain, and dead-band.
d. Provide 4 to 20 mA signal position control as shown on the Drawings that interfaces with the position control/position feedback instrumentation wiring to and from remote control device or PLC.

F. Electric Actuators (120 V, 1 PH):

1. General:
a. Conform to AWWA C542.
b. Self contained including motor, gearing, torque switch, limit switches and cast housing.
c. Electrical enclosure: NEMA 4X.
d. Factory assembled requiring only field connection of power and control wires.

2. Motors:
a. Produce 1.5 times the required torque.
b. Sized for 2 complete open-close cycles without overheating.
c. 1 fully closed to fully open cycle to occur within 60 SEC.
d. Class F insulation.
e. Operate at plus or minus 10 percent voltage.
f. 120V, single phase, 60 Hz.
g. Provide thermal cutout switch and internal heater for actuator enclosure.
h. Control wiring as shown on Drawing control diagrams.

3. Remote pushbutton station:
a. Enclosure: NEMA 4 stainless steel.
b. Control relays shall include:

1) Open relay.
2) Closed relay.
3) Remote control device or PLC interface relay.

c. Push-to-test indicating lights shall include:
1) Open.
2) Closed.
3) Remote.

d. Selector switches shall include:
1) Local-Remote.
2) Open-Close.

e. Space heater for enclosure.

f. Control wiring as shown on control diagrams.

g. Wire all components to an internal terminal strip and include mounted wiring diagram inside enclosure.

4. Controls:

a. Provide pre-wired control:
1) Provide 4-way, 2-position, 110 V solenoid valve in weatherproof enclosure.
2) Provide open-closed signal limit switches.
3) Manual-automatic selector valve on supply to solenoid.
4) For modulating valves, provide a positioner, input signal 4 to 20 mA, including signal converter.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Painting Requirements: Comply with Section 099600 for painting and protective coatings.

C. Install electric or cylinder actuators above or horizontally adjacent to valve and gear box to optimize access to controls and external handwheel.

3.2 ADJUSTMENT

A. Adjust actuators and appurtenant equipment to provide the required functionality. Operate valve, open and close at system pressures.

B. For all 120 Vac and 480 Vac electric actuators, employ and pay for services of valve actuator manufacturer's field service representative to:
1. Inspect valve actuators covered by this Specification Section.
2. Supervise adjustments and installation checks:
a. Open and close valves electrically under local manual and demonstrate that all limit switches are properly adjusted and that switch contacts are functioning properly by verifying the inputs are received at the remote input/output (RIO) panels or local control panel as appropriate.
b. Position modulating valves electrically under local manual control and demonstrate that the valve position feedback potentiometer is properly adjusted and that the feedback signal is received at the RIO panels or local control panel as appropriate.
c. Simulate a valve position command signal at the RIO panel or local control panel

as appropriate and demonstrate that the valve is controlled to the desired position without excessive hunting.

3. Provide Owner with a written statement that the valve actuator manufacturer has verified that the actuators have been installed properly, that all limit switches and position potentiometers have been properly adjusted and that the valve actuator responds correctly to the valve position command.

END OF SECTION 400557

SECTION 400559.23 – STAINLESS STEEL GATES

PART 1 – GENERAL

1.1 SUMMARY:

A. The CONTRACTOR shall furnish all labor, materials, equipment, and incidentals required to install, ready for operation and field test stainless steel gates and appurtenances as shown on the Contract Drawings and as specified herein.

B. The gates and appurtenances shall be supplied in accordance with the latest edition of AWWA C561 Standard for Fabricated Stainless Steel Slide Gates as modified herein.

C. Included in this Section is a Gate Schedule Table

1.2 SUBMITTAL:

A. Provide the following information to confirm compliance with the specification in addition to the submittal requirements.

1. Complete description of all materials including the material thickness of all structural components of the frame and slide.

2. General assembly drawings showing all details of construction, details required for installation, dimensions, and anchor bolt locations. General assembly drawings must be provided in 3D format.

3. Maximum bending stress and deflection of the slide under the maximum design head. Calculations for maximum operating load, hoist selection, and stem design.

1.3 QUALITY ASSURANCE:

A. All of the equipment specified under this Section shall be furnished by a single manufacturer with a minimum of 20 years' experience designing and manufacturing water control gates. The manufacturer shall have manufactured water control gates for a minimum of 100 projects.

B. The manufacturer's shop welds, welding procedures, and welders shall be qualified and certified in accordance with the requirement of the latest edition of ASME, Section IX or AWS D1.6 Structural Welding Stainless Steel.

C. The specification is based on the stainless-steel Gate as manufactured by Rodney Hunt, Inc of Orange, MA.

1.4 CONTAMINATION PREVENTION

A. In order to avoid contamination and maintain surface purity, the principle manufacturing facility must have a dedicated stainless-steel facility segregated and isolated from the facility where

products of other materials such as carbon steel or cast iron are manufactured. The stainless -steel material must be kept separated from other materials beginning from acquisition and storage through handling, fabrication, assembly, and dispatch

B. Mechanical removal of free iron particle, oil, dirt, paint, welding flux, slag, heat tint and scales of oxides must be supplemented with glass bead blasting followed by in house chemical bath pickling and passivation. Spray passivation or pickling and passivation performed by a third party is strictly not permitted.

1.5 CORROSION PREVENTION

A. To prevent crevice corrosion and advocate long life of stainless steel fabricated products, the principle manufacturer must only use continuous welding practices performed in house by the principle manufacturer. To verify the quality of the welds, a dye penetration test shall be conducted on all weld joints and approved by a quality control inspector.

1.6 MATERIAL PROPERTY ASSURANCE

A. Heatless cutting of stainless steel by a CNC water jet capable of 35,000 psi must be utilized to ensure there is no change in corrosion resistance properties of the stainless steel. Cutting methods utilizing heat will not be accepted.

PART 2 - EQUIPMENT

2.1 GENERAL

A. Each slide gate will be manufactured as detailed here and will be supplied fully tested as per requirements. To the maximum extent possible, the gate assembly comprising of frame, guides and slide will be supplied as a factory assembled unit and shipped to site ready to install on the wall thimble or wall.

B. The slide gates will be manufactured in accordance with AWWA C-561.

1. The gate manufacturer will be Rodney Hunt Inc. or approved equal.

C. The slide gates will be designed for water tightness for both seating and un-seating differential head per the actual site requirement as detailed in the Stainless Steel Slide Gate Table.

D. The slide gates will be shop tested to verify the leakage performance at operating head in the un-seating direction. Where sealing configuration permits, hydrostatic testing will be conducted at 1.5 times operating head, to demonstrate structural integrity. Testing for opening load at the unseating operating head to verify actuating mechanism sizing will also be conducted.

E. The slide gates will be of rising stem type unless site geometry prohibits it. Operation will be by means of a manual hoist, electric actuator or hydraulic cylinder as detailed in the Stainless Steel Slide Gate Table.

F. The slide gate will be supplied complete with all accessories such as: gate assembly, gasket, studs and nuts for mounting, stem, thrust nut, stem couplings, stem guides, pedestal, operating

mechanism as required, gate opening indicating arrangement and as required anchor bolts and fasteners for stem guides and pedestal.

G. The allowable leakage rate for the slide gates in this specification shall be 1/2 the allowable leakage listed in the latest revision of AWWA C561, 0.05 gpm/ft of wetted seal perimeter in seating head and unseating head conditions.

H. The gates shall utilize self-adjusting seals. Due to the difficulty of accessing gates when they are in service - gates that utilize adjustable wedges, wedging devices or pressure pads are not acceptable.

I. All structural components of the frame and slide shall be fabricated of stainless steel having a minimum thickness of 1/4-inch and shall have adequate strength to prevent distortion during normal handling, during installation and while in service.

J. All welds shall be performed by welders with AWS certification for the material grades used in fabrication.

K. The gate shall utilize self-adjusting seals. Due to the difficulty of accessing gates when they are in service - gates that utilize adjustable wedges, wedging devices or pressure pads are not acceptable.

L. All structural components of the frame and slide shall be fabricated of stainless steel having a minimum thickness of 1/4-inch and shall have adequate strength to prevent distortion during normal handling, during installation and while in service.

M. All welds shall be full and continuous performed by welders with AWS certification for the material grades used in fabrication.

N. Finish: Mill finish on stainless steel. Welds shall be sandblasted to remove weld burn and scale accompanied by passivation. All iron and steel components shall be properly prepared and shop coated with a primer.

2.2 GATE SCHEDULE

A. The following Gate Schedule is provided for reference to the Contractor. Contractor is responsible for verifying all gates shown on the plans prior to purchase and installation.

	PROJECT LOCATION	ASSOC. EQUIP.	INVERT ELEVATION (FT)	TOP OF WALL ELEVATION (FT)	OPENING WIDTH (IN)	OPENING HEIGHT (IN)	WATER LEVEL (FT)	RODNEY HUNT GATE SERIES	SELF-CONTAINED / NON SELF-CONTAINED (SC / NSC)	SURFACE/ WALL-FACE (S/WF) SIDE-WALL-EMBEDDED (SWE)	PEDESTAL MOUNT (P) / YOKE MOUNT (Y)	CLOSURE: CONVENTIONAL (C) / FLUSH-BOTTOM (FB)	EXTENDED BACK FLANGE (Y/N)	TAG ID
1	INFLUENT SPLITTER BOX	TO 24" SDR35 PVC	31.04	36.04	24	24	31.67	A-112	NSC	S/WF	P	FB	Y	2-SLD-1
2	INFLUENT SPLITTER BOX	TO 24" SDR35 PVC	31.04	36.04	24	24	31.67	A-112	NSC	S/WF	P	FB	Y	2-SLD-2
3	INFLUENT SPLITTER BOX	TO 24" SDR35 PVC	31.04	36.04	24	24	31.67	A-112	NSC	S/WF	P	FB	Y	2-SLD-3
4	INFLUENT SPLITTER BOX	TO 24" SDR35 PVC	31.04	36.04	24	24	31.67	A-112	NSC	S/WF	P	FB	Y	2-SLD-4
5	PROPOSED HEADWORKS BUILDING	MANUAL BAR SCREEN	29.874	32.73	36	32	31.46	A-211	SC	SWE	Y	FB	N	2-SLD-5
6	PROPOSED HEADWORKS BUILDING	MECH. BAR SCREEN	29.83	32.73	60	32	31.46	A-211	SC	SWE	Y	FB	N	2-SLD-6
7	EXISTING HEADWORKS BUILDING (REPLACE)	BYPASS CHANNEL BYPASS BARSCREEN	30.75	32.73	24	32	31.46	A-211	SC	SWE	Y	FB	N	2-SLD-7
8	EXISTING HEADWORKS BUILDING (REPLACE)	BYPASS CHANNEL MANUAL BARSCREEN	30.15	32.73	48	32	31.46	A-211	SC	SWE	Y	FB	N	2-SLD-8
9	EXISTING HEADWORKS BUILDING (REPLACE)	BYPASS CHANNEL WASHER COMPACTOR	30.15	32.73	48	32	31.46	A-211	SC	SWE	Y	FB	N	2-SLD-9
10	EXISTING HEADWORKS BUILDING (REPLACE)	BYPASS CHANNEL WASHER COMPACTOR	30.75	32.73	24	32	31.46	A-211	SC	SWE	Y	FB	N	2-SLD-10
11	PROPOSED GRIT SYSTEM	GRIT CHAMBER BYPASS	29.56	33.56	30	30	31.64	A-211	SC	SWE	Y	FB	N	2-SLD-11
12	PROPOSED GRIT SYSTEM	GRIT CHAMBER BYPASS	29.56	33.56	30	30	31.64	A-211	SC	SWE	Y	FB	N	2-SLD-12
13	PROPOSED GRIT SYSTEM	GRIT CHAMBER BYPASS	29.56	33.56	60	30	31.64	A-211	SC	SWE	Y	FB	N	2-SLD-13
14	EXISTING GRIT SYSTEM	GRIT CHAMBER BYPASS	29.15	33.15	30	36	31.25	A-211	SC	SWE	Y	FB	N	2-SLD-14
15	EXISTING GRIT SYSTEM	GRIT CHAMBER BYPASS	29.15	33.15	30	36	31.25	A-211	SC	SWE	Y	FB	N	2-SLD-15
16	EXISTING GRIT SYSTEM	GRIT CHAMBER BYPASS	29.15	33.15	60	36	31.25	A-211	SC	SWE	Y	FB	N	2-SLD-16
17	EXIST. DISTRIBUTION BOX	18" DIP TO SETTLING TANK 1	26.35	33.15	18	18	28.04	A-112	NSC	S/WF	P	FB	Y	2-SLD-17
18	EXIST. DISTRIBUTION BOX	18" DIP TO SETTLING TANK 4	26.35	33.15	18	18	28.04	A-112	NSC	S/WF	P	FB	Y	2-SLD-18
19	PROP. DISTRIBUTION BOX	OLD DIST BOX TO NEW DIST. BOX	29.15	33.15	48	18	30.41	A-211	SC	SWE	Y	FB	N	2-SLD-19
20	PROP. DISTRIBUTION BOX	18" SDR35 TO SETTLING TANK 2	26.35	33.15	18	18	28.04	A-112	NSC	S/WF	P	FB	Y	2-SLD-20
21	PROP. DISTRIBUTION BOX	18" SDR35 TO SETTLING TANK 3	26.35	33.15	18	18	28.04	A-112	NSC	S/WF	P	FB	Y	2-SLD-21
22	MBR MICROSCREEN BLD	18" SDR PRIMARY CLARIFIER #1 EFFLUENT	22.52	30.0	18	18	25.5	A-112	NSC	S/WF	P	C	Y	5-SLD-1
23	MBR MICROSCREEN BLD	18" SDR PRIMARY CLARIFIER #1 EFFLUENT	22.52	30.0	18	18	25.5	A-112	NSC	S/WF	P	C	Y	5-SLD-2

24	MBR MICROSCREEN BLD	18" SDR PRIMARY CLARIFIER #1 EFFLUENT	22.52	30.0	18	18	25.5	A-112	NSC	S/WF	P	C	Y	5-SLD-3
25	MBR MICROSCREEN BLD	18" SDR PRIMARY CLARIFIER #1 EFFLUENT	22.52	30.0	18	18	25.5	A-112	NSC	S/WF	P	C	Y	5-SLD-4
26	MBR MICROSCREEN BLD	DIST CHANNEL 1 TO MICROSCREEN #1	19.5	30.0	48	84	25.5	A-211	SC	SWE	Y	FB	N	5-SLD-5
27	MBR MICROSCREEN BLD	DIST CHANNEL 1 TO MICROSCREEN #2	19.5	30.0	48	84	25.5	A-211	SC	SWE	Y	FB	N	5-SLD-6
28	MBR MICROSCREEN BLD	MICROSCREEN #1 TO DIST CHANNEL 2	19.5	30.0	48	72	24.72	A-211	SC	SWE	Y	FB	N	5-SLD-7
29	MBR MICROSCREEN BLD	MICROSCREEN #2 TO DIST CHANNEL 2	19.5	30.0	48	72	24.72	A-211	SC	SWE	Y	FB	N	5-SLD-8
30	MBR INFLUENT PUMP STATION	DIST. CHANNEL 2 TO WET WELL 1	19.5	33.0	48	72	24.72	A-112	NSC	S/WF	P	FB	N	5-SLD-9
31	MBR INFLUENT PUMP STATION	DIST. CHANNEL 2 TO WET WELL 2	19.5	33.0	48	72	24.72	A-112	NSC	S/WF	P	FB	N	5-SLD-10
32	MBR INFLUENT PUMP STATION	WET WELL #1 TO WET WELL #2	16.67	33.0	48	48	24.43	A-112	NSC	S/WF	Y	FB	N	5-SLD-11
33	MBR BIOREACTOR #1	FROM INFLUENT SPLITTER BOX TO SLUICE TANK 1	37.32	40.78	72	29	38.67	A-311	SC	S/WF	Y	C	N	5-WRG-1
34	MBR BIOREACTOR #2	FROM INFLUENT SPLITTER BOX TO SLUICE TANK 2	37.32	40.78	72	29	38.67	A-311	SC	S/WF	Y	C	N	5-WRG-2
35	MBR BIOREACTOR #3	FROM INFLUENT SPLITTER BOX TO SLUICE TANK 3	37.32	40.78	72	29	38.67	A-311	SC	S/WF	Y	C	N	5-WRG-3
36	MBR BIOREACTOR #1	FROM SLUICE TANK TO ANOXIC ZONE 1	30.0	40.78	36	36	37.15	A-112	NSC	S/WF	P	FB	N	5-SLD-12
37	MBR BIOREACTOR #2	FROM SLUICE TANK TO ANOXIC ZONE 2	30.0	40.78	36	36	37.15	A-112	NSC	S/WF	P	FB	N	5-SLD-13
38	MBR BIOREACTOR #3	FROM SLUICE TANK TO ANOXIC ZONE 3	30.0	40.78	36	36	37.15	A-112	NSC	S/WF	P	FB	N	5-SLD-14
39	MBR BIOREACTOR #1	AEROBIC ZONE 4 TO MEMBRANE DISTRIB CHANNEL	35.5	40.78	96	51	36.94	A-311	SC	S/WF	Y	C	N	5-WRG-4
40	MBR BIOREACTOR #2	AEROBIC ZONE 5 TO MEMBRANE DISTRIB CHANNEL	35.5	40.78	96	51	36.94	A-311	SC	S/WF	Y	C	N	5-WRG-5
41	MBR BIOREACTOR #3	AEROBIC ZONE 6 TO MEMBRANE DISTRIB CHANNEL	35.5	40.78	96	51	36.94	A-311	SC	S/WF	Y	C	N	5-WRG-6

42	MBR TREATMENT TRAIN #1	MEMBRANE DISTRIBUTION CHANNEL TO MBR TRAIN #1	24.5	37.5	36	36	35.39	A-112	NSC	S/WF	P	FB	N	5-SLD-15
43	MBR TREATMENT TRAIN #2	MEMBRANE DISTRIBUTION CHANNEL TO MBR TRAIN #2	24.5	37.5	36	36	35.39	A-112	NSC	S/WF	P	FB	N	5-SLD-16
44	MBR TREATMENT TRAIN #3	MEMBRANE DISTRIBUTION CHANNEL TO MBR TRAIN #3	24.5	37.5	36	36	35.39	A-112	NSC	S/WF	P	FB	N	5-SLD-17
45	MBR TREATMENT TRAIN #4	MEMBRANE DISTRIBUTION CHANNEL TO MBR TRAIN #4	24.5	37.5	36	36	35.39	A-112	NSC	S/WF	P	FB	N	5-SLD-18
46	MBR DISTRIBUTION CHANNEL	DISTRIBUTION CHANNEL TO SCUM PIT	33.5	37.5	30	30	35.39	A-112	NSC	S/WF	P	C	N	5-SLD-19
47	BACKPULSE PUMP STATION	BACKPULSE TANK PARTION WALL	0	14	48	48	12	A-112	NSC	S/WF	P	FB	N	6-SLD-1
48	BACKPULSE PUMP STATION	PUMP AREA TO DISINFECTION TANK (30" DIMJ)	6.2	14	30	30	12	A-112	NSC	S/WF	P	C	Y	6-SLD-2
49	AERATION TANK CHLOR/DECHLOR	EXISTING PLASTIFAB GATE INFLUENT	6	14	36	36	11.24	N/A	NSC	S/WF	P	C	N	6-SLD-3
50	AERATION TANK CHLOR/DECHLOR	EXISTING PLASTIFAB GATE INFLUENT	6	14	36	36	11.24	N/A	NSC	S/WF	P	C	N	6-SLD-4
51	AERATION TANK CHLOR/DECHLOR	EXISTING PLASTIFAB GATE EFFLUENT	5.7	14	36	36	11.24	N/A	NSC	S/WF	P	C	N	6-SLD-5
52	AERATION TANK CHLOR/DECHLOR	EXISTING PLASTIFAB GATE EFFLUENT	5.7	14	36	36	11.24	N/A	NSC	S/WF	P	C	N	6-SLD-6

2.3 FRAME

A. The frame assembly, including the guide members, invert member and yoke members, shall be constructed of stainless steel plate with a minimum thickness of 1/4-inch.

1. Frame design shall allow for embedded mounting, mounting directly to a wall with stainless steel anchor bolts and grout or mounting to a wall thimble with stainless steel mounting studs and a mastic gasket material. Mounting style shall be as shown on the Contract Drawings.

2. All wall mounted or wall thimble mounted gates shall have a flange frame. Flat frame gates are not acceptable.

3. Gussets shall be provided as necessary to support the guide members in an unseating head condition.

4. The frame shall extend to accommodate the entire height of the slide when the slide is in the fully opened position on upward opening slide gates or downward opening weir gates.

5. On self-contained gates, a yoke shall be provided across the top of the frame. The yoke shall be formed by a structural members affixed to the top of the side frame members to provide a one-piece rigid assembly. The yoke shall be designed to allow removal of the slide.

6. A rigid stainless-steel invert member shall be provided across the bottom of the opening. The invert member shall be of the flush bottom type on upward opening gates.

7. A rigid stainless steel top seal member shall be provided across the top of the opening on gates designed to cover submerged openings.

8. A rigid stainless-steel member shall be provided across the invert of the opening on downward opening weir gates.

2.4 SLIDE

A. The slide and reinforcing stiffeners shall be constructed of stainless steel plate. All structural components shall have a minimum thickness of 1/4-inch.

1. The slide shall not deflect more than 1/360 of the span or 1/16 inch, whichever is smaller, under the maximum design head.

2. Reinforcing stiffeners shall be continuously welded (stitch welding will not be acceptable) to the slide and mounted horizontally. Vertical stiffeners shall be

continuously welded on the outside of the horizontal stiffeners for additional reinforcement.

3. The stem connector shall be constructed of two angles or plates. The stem connector shall be continuously welded to the slide. A minimum of two bolts shall connect the stem to the stem connector.

2.5 SEALS

A. All gates shall be provided with a self-adjusting seal system to restrict leakage in accordance with the requirements listed in this specification.

1. All gates shall be equipped with UHMW polyethylene seat/seals to restrict leakage and to prevent metal to metal contact between the frame and slide.

2. The seat/seals shall extend to accommodate the 1-1/2 x the height of the slide when the slide is in the fully closed or fully opened position.

3. All upward opening gates shall be provided with a resilient seal to seal the bottom portion of the gate. The seal shall be attached to the invert member or the bottom of the slide and shall be held in place with stainless steel attachment hardware.
4. All downward opening weir gates shall be provided with UHMW polyethylene seat/seals across the invert member.

5. The seal system shall be durable and shall be designed to accommodate high velocities and frequent cycling without loosening or suffering damage.

6. All seals must be bolted or otherwise mechanically fastened to the frame or slide.
7. The seals shall be mounted so as not to obstruct the water way opening.

8. Gates that utilize rubber “J” seals or “P” seals are not acceptable.

9. The seal system shall have been factory tested to confirm negligible wear (less than 0.01”) and proper sealing. The factory testing shall consist of an accelerated wear test comprised of a minimum of 100,000 open-close cycles using a well-agitated sand/water mixture to simulate fluidized grit.

2.6 WALL THIMBLES

A. Wall thimbles shall be provided when shown on the Contract Drawings.

1. The wall thimble depth shall be equal to the thickness of the concrete wall in which the thimble is to be mounted.

2. Wall thimbles shall be fabricated stainless steel construction of adequate section to withstand all operational and reasonable installation stresses.

3. Wall thimbles shall be constructed of 1/4-inch minimum thickness stainless steel and the front face shall have a minimum thickness of 1/4–inch.

4. The fabrication process shall ensure that the wall thimble is square and plumb and the front face is sufficiently flat to provide a proper mounting surface for the gate frame.

5. The face of the wall thimble shall only be machined if recommended by the gate manufacturer. If the wall thimble is to be machined, the front face shall have a minimum thickness of 1/4-inch after machining.

6. A water stop shall be welded around the periphery of the thimble. Wall thimbles shall be designed to allow thorough and uniform concrete placement during installation.

7. Studs and nuts shall be stainless steel. Water stop may be stitch welded.

8. A suitable gasket or mastic shall be provided to seal between the gate frame and the wall thimble.

2.7 OPERATING STEM

A. The slide gates will be supplied with rising type operating stems unless non-rising stems are required by installation geometry.

1. The stem will be supplied with ACME full or stub threading. The stem will be designed to allow for elevation deviations of up to 2”.

2. The stem shall be constructed of solid stainless-steel bar for the entire length, the metal having a tensile strength of not less than 90,000 psi for stems that are 3 inches or less in diameter. Stems that are in excess of 3 inches in diameter shall have a tensile strength of 85,000 psi.

3. The threaded portion of the stem shall have a minimum outside diameter of 1-1/2 inches. Stem extension pipes are not acceptable.

4. The design of stem will be per the provision in AWWA C-561.

5. The L/r ratio will not exceed 200.

6. For buckling, Euler’s formula will be used with an end condition of 2.0. For threaded sections, the radius of gyration will be based on the minor diameter. At the stem design load as follows, the yield strength of the material will not be exceeded.

7. As a minimum for manual hoists, the stem design load is the load produced with a 100 pound effort on the crank or handwheel.

8. For electric actuators, the stem design load is the greater of the load produced with a 100 pound handwheel effort and 1.50 times the load produced at a locked rotor condition.

9. For hydraulic actuation, the stem design load will be 1.25 times the thrust produced at system relief pressure.

10. Stems of more than one section shall be joined by stainless steel or bronze couplings. The coupling shall be threaded and bolted to the stems.

11. Stems shall be provided with adjustable stop collars to prevent over closing of the slide.

2.8 STEM GUILD

A. Stem guide shall be provided when necessary to ensure that the maximum L/R ratio for the unsupported part of the stem is 200 or less.

B. Stem guide brackets shall be fabricated of stainless steel and shall be outfitted with UHMW or bronze bushings.

C. Wall mounted stem guides will be adjustable in two directions, providing at least 0.50” of adjustment in both directions. Wall brackets will be stainless steel.

D. Wall mounted stem guides will have machine bored, split bushings to facilitate erection. Bushings will be bronze or UHMWPE. Stem guides mounting at the base of the pedestal do not require adjustment.

2.9 MANUAL OPERATOR MECHANISMS

A. Unless otherwise shown on the Drawings, gates shall be operated by a manual handwheel or a manual crank-operated gearbox. The operator shall be mounted on the yoke of self-contained gates or on the pedestal of non-self-contained gates.

B. The gate manufacturer shall select the proper gear ratio to ensure that the gate can be operated with no more than a 40 lb. effort when the gate is in the closed position and experiencing the maximum operating head.

C. An arrow with the word “OPEN” shall be permanently attached or cast onto the operator to indicate the direction or rotation to open the gate.

D. Handwheel operators shall be fully enclosed and shall have a cast aluminum housing.

1. Handwheel operators shall be provided with a threaded cast bronze lift nut to engage the operating stem.

2. Handwheel operators shall be equipped with roller bearings above and below the operating nut.

3. Positive mechanical seals shall be provided above and below the operating nut to exclude moisture and dirt and prevent leakage of lubricant out of the hoist.

4. The handwheel shall be removable and shall have a minimum diameter of 15 inches.

E. Crank-operated gearboxes shall be fully enclosed and shall have cast aluminum or ductile iron housing.

1. Gearboxes shall have either single or double gear reduction depending upon the lifting capacity required.

2. Gearboxes shall be provided with a threaded cast bronze lift nut to engage the operating stem.

3. Bearings shall be provided above and below the flange on the operating nut to support both opening and closing thrusts.

4. Gears shall be steel with machined cut teeth designed for smooth operation. The pinion shaft shall be stainless steel and shall be supported on ball or tapered roller bearings.

5. Positive mechanical seals shall be provided on the operating nut and the pinion shafts to exclude moisture and dirt and prevent leakage of lubricant out of the hoist.

6. The crank shall be cast aluminum or cast iron with a revolving nylon grip.

7. The crank shall be removable.

F. All gates having widths in excess of 72 inches and widths greater than twice their height shall be provided with two gearboxes connected by an interconnecting shaft for simultaneous operation.

1. Interconnecting shafting shall be constructed of aluminum or stainless steel. Flexible couplings shall be provided at each end of the interconnecting shaft. One crank shall be provided to mount on the pinion shaft of one of the gearboxes.

G. An extended operator system utilizing chain and sprockets shall be furnished by the manufacturer when the centerline of the crank or handwheel, on a non-geared operator, is located over 48 in above the operating floor. Chain wheels are not acceptable.

1. A removable stainless steel or aluminum cover shall be provided to enclose chain and sprockets.

2. The extended operator system shall lower the centerline of the pinion shaft to 36 in above the operating floor.

3. A handwheel may be utilized in conjunction with a gearbox in lieu of the extended operator system if the centerline of the pinion shaft is 60 in or less above the operating floor.

H. Pedestals shall be constructed of stainless steel. Aluminum pedestals are not acceptable.

1. The pedestal height shall be such that the handwheel or pinion shaft on the crank-operated gearbox is located approximately 36 in above the operating floor.
2. Wall brackets shall be used to support floor stands where shown on the drawings and shall be constructed of stainless steel.
3. Wall brackets shall be reinforced to withstand in compression at least two times the rated output of the operator with a 40 lb. effort on the crank or handwheel.
4. The design and detail of the brackets and anchor bolts shall be provided by the gate manufacturer and shall be approved by the ENGINEER.
5. The gate manufacturer shall supply the bracket, anchor bolts and accessories as part of the gate assembly.

I. Operators shall be equipped with polycarbonate plastic stem covers.

1. The top of the stem cover shall be closed and vented. Gate opening indication will be provided on the stem cover for all non-rising stem gates. A full height scale will be mounted on the side of the stem cover and an indicator nut mounted on the rising stem to show gate position. The scale graduation will be 1”.

2. The bottom end of the stem cover shall be mounted in a housing or adapter for easy field mounting.

3. Stem covers shall be complete with indicator markings to indicate gate position.

4. When shown on the Contract Drawings, provide a stainless steel 2-inch square nut, mounted in a floor box, with a non-rising stem shall be provided.

5. The floor box shall be constructed of stainless steel or cast iron and shall be set in the concrete floor above the gate as shown.

6. Provide one aluminum or stainless-steel T-handle wrench for operation.

2.10 ELECTRIC MOTOR ACTUATORS

A. See Section 400557 Actuators for Process Valves and Gates.

2.11 ANCHOR BOLTS

A. Anchor bolts shall be provided by the gate manufacturer for mounting the gates and appurtenances.

1. Quantity and location shall be determined by the gate manufacturer.

2. If epoxy type anchor bolts are provided, the gate manufacturer shall provide the studs and nuts.

3. Anchor bolts shall have a minimum diameter of 1/2-inch.

PART 3 – MATERIAL OF CONSTRUCTION

3.1 The gates shall be manufactured using the materials in the table below.

A.	Frame Assembly and Retainers:	Slide and Stiffeners: Stainless Steel, ASTM A240 Type 304L
B.	Slide and Stiffeners:	Stainless Steel, ASTM A240 Type 304L
C.	Stem:	Stainless Steel, ASTM A276Type 304
D.	Fasteners, Nuts and Bolts:	Stainless Steel, ASTM A276 Type 304
E.	Invert Seal Neoprene or EPDM (Upward Opening Gates Only):	GR1 for type 304 ASTM D-2000

F.	Seat/Seals and Facing:	Ultra-High Molecular Weight Polyethylene ASTM D4020
G.	Lift Nuts:	Bronze ASTM B584
H.	Pedestals and Wall Brackets:	Stainless Steel, ASTM A276 Type 304L, or ASTM A240 Type
I.	Operator Housing:	Cast Aluminum or Ductile Iron

PART 4 - EXECUTION

4.1. INSTALLATION

A. Installation of the gates and appurtenances shall be done in a workmanlike manner. It shall be the responsibility of the CONTRACTOR to handle, store and install the equipment specified in this Section in strict accordance with the manufacturer's recommendations.

B. The CONTRACTOR shall review the installation drawings and installation instruction prior to installing the gates.

C. The gate assemblies shall be installed in a true vertical plane, square and plumb.

D. The CONTRACTOR shall fill the void in between the gate frame and the wall with non-shrink grout as shown on the installation drawing and in accordance with the manufacturer's recommendations.

E. The CONTRACTOR shall add a mastic gasket between the gate frame and wall thimble (when applicable) in accordance with the manufacturer's recommendations.

4.2. FIELD TESTING

A. After installation, all gates shall be field tested in the presence of the ENGINEER and OWNER to ensure that all items of equipment are in full compliance with this Section. Each gate shall be cycled to confirm that they operate without binding, scraping, or distorting. The effort to open and close manual operators shall be measured and shall not exceed the maximum operating effort specified above. Electric motor actuators shall function smoothly and without interruption. Each gate shall be water tested by the CONTRACTOR, at the discretion of the ENGINEER and OWNER, to confirm that leakage does not exceed the specified allowable leakage.

END OF SECTION 400559.23

SECTION 4000561.43 – KNIFE GATE VALVES

PART 1 - GENERAL

1.1 SCOPE:

A. This section describes the requirements for a Urethan Lined Knife Gate Valve for abrasive and or/corrosive service in dry, liquid, and slurry applications.

B. Under this item, the contractor shall furnish and install any Knife Gate as indicated on the plans and as herein specified.

1.2 REFERENCES:

A. ASME B16.1 and ASME B16.5 Pipe Flanges and Flanged Fittings

B. ASME B16.20 Metallic Gaskets for Pipe Flanges

C. MSS SP-81 Stainless Steel Knife Gate Valves with Flanged Ends

D. ANSI/AWWA C606 Grooved and Shouldered Joints

1.3 SUBMITTALS:

A. The Contractor shall not deliver nor place any materials, until such time that shop drawings for each material used in the work has been submitted and accepted by the Engineer.

B. Shop Drawings shall indicate the size, construction, assembly, materials of manufacture, dimensions, and all other pertinent information to indicate compliance with this Specification and as required, such that the system can be determined acceptable by the Engineer.

C. Shop Drawing submittals shall conform to the requirements of the General Conditions.

1.4 WARRANTY

A. Valves shall be warranted by the manufacturer for defects in materials and workmanship for a period of two years (24 months) from date of shipment.

PART 2 – PRODUCTS

2.1 GENERAL:

A. Valves, actuators, and positioners shall be provided by DeZurik, Clow, Kennedy, or acceptable equal.

B. Knife Gate Valve shall be bonnetless, Urethane Lined, Bi-Directional Cast Knife Gate

2.2 DESIGN:

A. Body:

1. One-piece cast ductile iron. Flanged valves shall conform to ASME B36.1, 125 lbs. Valve body shall be rated at (150 psi; 1030 kPa) maximum cold working pressure. Cold Working Pressure valve rating shall meet or exceed MSS SP-81 on valve 2-24" (50-500mm).
   a. Flanged. Valve inside diameter shall be 100% of adjacent pipe area equal to ANSI B36.10 STD pipe inside diameter.
   b. Grooved. Valve inside diameter shall conform to MSS SP-81.

B. Urethane Liner:

1. Shall be cast, bonded, and seamless, rated for temperatures between -20º F up to 265º F (-29º C to 130º C) as dictated by urethane selection. Urethane shall be standard urethane black. All wetted surfaces of the body shall be urethane lined including entire port, chest cavity, and packing box.
2. Flanged valves shall include urethane raised or flat face on each side of the valve requiring no gaskets. Gaskets are required when mating to Fiberglass Reinforced Flanges.

C. Gate:

1. The gate shall be (304) stainless steel for 150 psi maximum Cold Working Pressure or (17-4 Heat Treated) (410 Heat Treated) or (2205 Duplex) Stainless Steel for 250 psi maximum Cold Working Pressure. Gate edge shall be radiused and machined to reduce friction and extend life of valve packing and have a 45-degree beveled knife edge.

D. Packing System:

1. Low Maintenance Packing System shall fit a machined rounded packing chamber. The packing system shall consist of multiple layers of packing. The selected packing shall be for wet service. Packing gland material shall be 316 stainless steel. The fasteners shall be stainless steel.

E. Face to Face Dimensions:

1. Standard Flange Valve shall meet MSS SP81 for knife gate valves on 2-24" (50-600mm).

2. Grooved End Valves shall meet ANSI/AWWA C606-15 (Style 77 Table 4), Style 31 Table 2), (Style 31 Table 3).

3. Extended Flange Valve shall meet industry accepted standard for "long-pattern", slurry push-through design valve with backing rings sizes 2-48". Option length without backing rings available in sizes 2-8".

2.3 ACTUATORS

A. Shall be provided and compatible for all applicable valves shown on the plans, unless otherwise noted

B. All actuators shall be properly sized for the intended applications.

C. Manual operated actuators yoke shall be one piece cast carbon steel or approved equal.

D. The stem shall be type 304 stainless steel. A standard locking device shall be available upon request. The lockout shall be rated to withstand the maximum output of the actuator.

E. Toque conditions after thee (3) years of service should be used in sizing of actuators.

2.4 MATERIALS

A. BODY: Cast Ductile Iron, ASTM A395 65-45-15

B. GATE: 304 stainless steel

C. Urethane Liners available in seven formulations consisting of polyether, polyester, and polybutadiene.

D. Bolting/Hardware: Stainless steel

2.5 TESTING

A. Valves to be tested in accordance with MSS SP-151 specification. The valves shall be seat tested and drip tight to full rated pressure in either direction. The bodies shall be shell tested to 1.5 times the rated pressure.

B. Certified test reports shall be available upon request.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install valves as specified in section (application specific requirements provided by the engineer) and the manufacturer’s instructions.

END OF SECTION 4000561.43

SECTION 400565– BALL CHECK VALVES

PART 1 - GENERAL

1.1 SCOPE:

A. This section describes the requirements for a Ball Check Valve for abrasive and or/corrosive service in dry, liquid, and slurry applications.

B. Under this item, the contractor shall furnish and install any Ball Check Valve as indicated on the plans and as herein specified.

1.2 REFERENCES:

A. AWWA C507-05 Ball Valves, 4 in. through 48 in.

B. ASTM A536, Grade 65-45-12 “Ductile Iron”

1.3 SUBMITTALS:

A. The Contractor shall not deliver nor place any materials, until such time that shop drawings for each material used in the work has been submitted and accepted by the Engineer.

B. Shop Drawings shall indicate the size, construction, assembly, materials of manufacture, dimensions, and all other pertinent information to indicate compliance with this Specification and as required, such that the system can be determined acceptable by the Engineer.

C. Shop Drawing submittals shall conform to the requirements of the General Conditions.

1.4 WARRANTY

A. Valves shall be warranted by the manufacturer for defects in materials and workmanship for a period of two years (24 months) from date of shipment.

PART 2 – PRODUCTS

2.1 GENERAL:

A. Ball check valves shall be designed to be non-clog, fully automatic, low maintenance and specifically suited for operation in raw sewage where solids, fibers, grit or highly viscous materials are encountered.

B. Ball check valves will be provided with one moving part, the ball. The ball shall automatically roll out of the path of flow providing an unobstructed full flow equal to nominal size. Upon cessation of flow, the ball automatically rolls back to the closed position providing a positive seal against backflow.

C. Ball check valves are designed to be maintenance free and suited for installation in the horizontal or vertical position. The valve shall be so constructed that by unbolting and lifting off the cover, the ball may be removed and replaced without removing the valve from the line.

2.2 MATERIALS

A. Ball check valves shall be Model 5087 as manufactured by Flygt.

B. Valve size shall match line size.

C. Body material shall be Nodular Cast Iron Type GGG40/ASTM 65-45-12/SAE D4512

D. Flange drilling ANSI B16.1 Class 125 Flat Faced Bolt holes straddle centerline.

E. Ball shall be metal corewith vulcanized nitrile rubber covering. Sinking Type specific gravity greater than 1.0. Floating Type specific gravity less than 1.0.

F. Working Pressure shall be 145 psi max.

G. Working temperature shall be 176 degrees Fahrenheit max. (212 degreed Fahrenheit max with optional EPDM-coated ball).

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install valves as specified in section (application specific requirements provided by the engineer) and the manufacturer’s instructions at the location shown on the plans.

B. Valves shall be operated to determine that they area in correct operating condition and do not leak, prior to the completion of the backfilling, after hydrostatic and leakage tests are completed.

END OF SECTION 400565

SECTION 402301 – STAINLESS STEEL AND CARBON STEEL PROCESS AIR PIPING

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The Contractor shall furnish all labor, materials, equipment and incidentals required and install, test complete and ready for operation all process air stainless steel and carbon steel pipe as shown on the Drawings and as specified herein.

B. Where the word “pipe” is used, it shall refer to pipe, fittings, hangers, supports and appurtenances unless otherwise noted.

1.2 RELATED WORK

A. Valves and appurtenances are included in Section 400552

B. Pipe hangers and supports are included in Section 400507.

C. Pipe insulation is included in Section 404213.1

1.3 SUBMITTALS

A. The Contractor shall submit to the Engineer shop drawings and product data including piping layouts and schedules required to establish compliance with this section.

1. Flexible pipe connectors.
2. Safety Valves.
3. Pressure Regulators. Include rated capacities and operating characteristics.
4. Automatic drain valves.
5. Filters. Include rated capacities and operating characteristics.
6. Quick couplings.
7. Hose assemblies.

1.4 REFERENCE STANDARDS

A. American Society for Testing and Materials (ASME)
   1. Comply with ASME B31.9, “Building Services Piping.” For low-pressure air piping.
   2. Comply with ASME B31.3 “Process Piping Guide”.

B. Where reference is made to one of the above standards, the revision in effect at the same time of bid opening shall apply.

1.5 QUALITY ASSURANCE

A. All pipe and fittings shall be furnished by a single manufacturer who is fully experienced, reputable, qualified and regularly engaged for the last five years in the manufacture of the materials to be furnished. The pipe and fittings shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these Specifications.

B. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or to AWS B2.2, "Standard for Brazing Procedure and Performance Qualification.

1.6 SYSTEM DESCRIPTION

A. Piping shall be installed in those locations as shown on the Drawings.

B. The equipment and materials specified herein are intended to be standard types of stainless-steel pipe and fittings for use in transporting air.

C. All stainless-steel not specified shall be Type 316L unless otherwise specified on the Drawings.

D. All steel pipe shall be Schedule 10 unless otherwise specified on the Drawings.

1.7 DELIVERY, STORAGE AND HANDLING

A. Care shall be taken in loading, transporting and unloading to prevent injury to the pipe and fittings. Pipe and fittings shall not be dropped. Pipe and fittings shall be examined before installation and no piece shall be installed which is found to be defective.

B. In handling the pipe, wide cushioned slings or other devices and methods acceptable to the Engineer shall be used. No uncushioned ropes, chairs, wedges or levers shall be used in handling the pipe, fittings and couplings.

C. If any defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe by the Contractor, at the Contractor’s own expense. All pipe and fittings shall be thoroughly cleaned before installation and shall be kept clean until they are put into service.

PART 2 PRODUCTS

2.1 MATERIALS

A. Schedule 10, Steel Pipe: ASTM A 53/A 53M.

B. Transition Couplings for Metal Piping: Metal coupling or other manufactured fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.2 JOINING MATERIALS

A. Pipe-Flange Gasket Materials:
   1. ASME B16.5, Class 125 stainless steel flanges..

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated.

2.3 VALVES

A. Metal Ball, Butterfly, Check, Gate, and Globe Valves: Comply with requirements in Division 40 Section "Stainless Steel Pipe and Fittings.".

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Low-Pressure Air Distribution Piping:
   1. Schedule 10, stainlesss-steel pipe;
   2. Schedule 10, carbon-steel pipe.

3.2 INSTALLATION

A. All stainless-steel pipe shall be installed as specified in Section 400523.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Install air and drain piping with a 1 percent slope downward in direction of flow.

D. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating, unless otherwise indicated.

3.3 JOINING MECHANICAL AND RESTRAINED JOINTS

A. Restrained joint pipe and fittings shall be installed in the locations shown on the Drawings and as acceptable to the Engineer.

3.4 JOINING FLANGED JOINTS

A. Flanged joints shall be made with gasket, bolts and nut bolts with a nut on each end, or studs with nuts where the pipe is tapped. The number and size of bolts shall conform to the same standard requirements as the flange.

3.5 FIELD WELDING, FIELD PAINTING, AND FIELD TESTING

A. All field welding and field paintings shall be done in accordance with Division 40 Section 400523 “Stainless Steel Pipe and Fittings”.

B. Testing of air process piping shall be pneumatically tested in accordance with ASME B3.13. Test pressure shall be 1.5 times the normal operating pressure.

END OF SECTION 402301

SECTION 402323 – PVC PROCESS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION

A. The Contractor shall furnish and install polyvinyl chloride (PVC) piping on all above grade potable water lines shown in the Contract Plans. Transitions to underground piping shall be made with the appropriate transition coupling.

B. Piping system includes piping, fittings, anchors, transition couplings, terminations, access tees, carrier pipe supports and associated pipe joining method.

C. System shall be of uniform materials.

1.3 RELATED SECTIONS

A. See Division 40 Section “Piping Insulation” for pipe insulation specifications.

B. See Division 40 Section “Hangars and Supports” for piping support requirements.

1.4 REFERENCE STANDARDS

A. ASTM D1785: Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120.

B. ASTM D2464: Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

C. ASTM D2466: Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

D. ASTM D2467: Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

E. ASTM D2564: Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.

F. ASTM D2609: Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe.

G. ASTM D2855: Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.

H. ASTM D3139: Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

I. AWWA C900: Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. through 12 in., for Water Distribution.

J. AWWA C901: Polyethylene (PE) Pressure Pipe and Tubing, 1/2 in. through 3 in., for water service.

K. AWWA C905: Polyvinyl Chloride (PVC) Pressure Pipe and Fittings, 14 in. through 48 in., for Water Distribution.

1.5 SUBMITTALS

A. Product data for piping including details of construction relative to materials, dimensions of individual components, profiles, and finishes.

B. Product certificates showing ANSI/NSF compliance for use with potable water.

1.6 QUALITY ASSURANCE

A. Obtain components from a single source having responsibility and accountability to answer and resolve problems regarding proper installation, compatibility, performance and acceptance.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver double-containment piping as a factory assembled unit with protective wrapping/coverings.

B. Store products on elevated platforms in a dry location with protection from elements.

C. Lift, support, and transport piping per manufacturer’s recommendations.

1.8 WARRANTY

A. Warranty period is one year after date of substantial completion of installation.

1.9 EXTRA MATERIALS

A. Turn over to owner, at end of construction, necessary Assembly, Maintenance and Operating Instructions as suggested by manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to the compliance with requirements and products that may be incorporated into the work include:
   1. Charlotte Pipe and Foundry Company, Inc.;
   2. Harrison Machine and Plastic Corporation, Tel: (330) – 527 –5641;
   3. Georg Fischer Harvel, LLC.;
   4. Lasco Fittings, (800) 776-2756;
   5. Approved equal.

2.2 MATERIALS

A. Product Pipe: Pipe and fittings shall be Polyvinyl Chloride meeting ASTM D 2467 standards. Schedule 80 PVC Pipe with a minimum operating pressure rating of 210 psi. Pipe and fittings shall be certified to ANSI/NSF 61 for potable water service.

B. Sight Glass Segments: Clear PVC, Schedule 40 above 6" in diameter, Schedule 80 at 6" diameter or less.

2.3 FITTINGS

A. Flanged fittings shall meet ANSI class 150 at all locations except distribution pump discharge piping.

B. Distribution pump discharge flanges shall be ANSI 300 class.

C. Backwash influent piping shall be ANSI 300 class until the pressure reducing valve. Piping after the pressure reducing valve shall be ANSI class 150.

D. Solvent weld fittings may be used on piping provided pressure ratings exceed the maximum operating pressures shown on the Contract plans. Contractor shall provide certification from manufacturer that welded piping system is rated to handle the stated pressures.

2.4 IDENTIFICATION

A. As specified in Section 400508 "Process Piping Identification."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install piping to comply with manufacturer's recommended procedures.

B. All joining shall be done utilizing flange gaskets of the appropriate pressure ratings.

C. Solvent weld joints may be utilized on piping less than 3” in diameter provided pressure ratings are met.

D. Support piping per Division 40 section “Hangars and Supports”.

3.2 TESTING

A. Pressure testing shall be conducted as specified in Section 330110.13 “Pressure and Leakage Testing of Pipes.”

B. Disinfection testing shall be per AWWA 563-13 and New York State and/or local county Health Department requirements. Additional details may be specified on the Contract Plans.

C. Laboratory tests shall be conducted by a New York State Certified Laboratory.

D. Contractor shall supply Engineer with a copy ofall test results.

END OF SECTION 402323

SECTION 402400 – CHEMICAL FEED PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The Contractor shall furnish and install double walled chemical feed piping system on all below and/or on ground piping containing concentrated chemicals. Contractor shall also furnish and install double walled chemical feed piping where shown on plans. All above ground piping shall not be required to have an outside or containment pipe.

B. Piping system includes piping, fittings, anchors, terminations, access tees, carrier pipe supports and associated pipe joining method.

C. System shall be of uniform materials.

D. See Section 414010 “Remote Fill Station” for remote fill box specifications.

1.1 STANDARDS:

A. The following standards apply to products used within this section:
   a. ASTM D 1784
   b. ASTM D 1970
   c. ASTM D 1985
   d. ASTM D 2466
   e. ASTM D 2467
   f. ASTM D 2464
   g. ASTM D 2564

1.2 DEFINITIONS:

A. Product Pipe: Inside Pipe or Carrier Pipe.

B. Containment Pipe: Outside Pipe

1.3 SUBMITTALS:

A. Product data for each type of double-containment specified including details of construction relative to materials, dimensions of individual components, profiles, and finishes.

B. Product certificates signed by manufacturer of double-containment product stating compliance with stated requirements.

C. Qualifications of firms supplying double-containment piping. Firms must have a minimum of 10 years experience in the design, installation and operation of a thermoplastic double-wall piping system.

1.4 QUALITY ASSURANCE

A. Obtain components from a single source having responsibility and accountability to answer and resolve problems regarding proper installation, compatibility, performance and acceptance.

B. Design, fabricate and install double-containment piping to meet ASME/ANSI B31.3 where applicable manufacturer shall provide thermal stress analysis demonstrating the ability of the double-containment piping system to handle the stated piping conditions with a restrained or a flexible design, as follows:

1. **Restrained Design:** The system shall be restrained with no accommodation for inner-pipe movement. Manufacturer or Design Engineer should be consulted for the proper location of anchors.

2. **Flexible Design:** The system shall be a flexible design with provisions to allow inner and outer pipe ability to move independent of one another. Anchors will be selectively used to direct thermal expansion into expansion loops, and/or offsets, etc. Manufacturer or Design Engineer should be consulted for the proper location of anchors and expansion compensation design.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver double-containment piping as a factory assembled unit with protective wrapping/coverings.

B. Store products on elevated platforms in a dry location with protection from elements.

C. Lift, support, and transport double-containment piping per manufacturer's recommendations.

1.6 WARRANTY

A. Warranty period is one year after date of substantial completion of installation.

1.7 EXTRA MATERIALS

A. Turn over to owner, at end of construction, necessary Assembly, Maintenance and Operating Instructions as suggested by manufacturer.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Subject to the compliance with requirements and products that may be incorporated into the work include PRO-LOCK PVC Double Containment by Asahi/America, Inc., of Malden, Massachusetts, 1-800-343-3618; or approved equal.

2.2 MATERIALS

A. Product Pipe: Pipe and fittings shall be Polyvinyl Chloride with a Cell Classification of 12454-B in accordance with ASTM D 1784.

B. Containment Pipe: Same as product pipe.

2.3 PRESSURE RATING PIPES

Both inner and outer pipes shall conform to requirements for establishing a hydrostatic design basis.

A. Product Pipe
Shall be Schedule 80 PVC Pipe shall be Iron Pipe Size Dimensions manufactured in accordance with ASTM D 1785.
Fittings shall be produced in accordance with ASTM D-2467.
Product Pipe shall be in sizes 1", 1-1/2" 2", 3, and 4"

B. Containment Pipe
Shall be Schedule 40 PVC Pipe shall be Iron Pipe Size Dimensions manufactured in accordance with ASTM D 1785.
Fittings shall be produced in accordance with ASTM D-2466.
Containment pipe shall be at least 1 size larger than Product Pipe, or as recommended by the manufacturer.
Containment pipe above grade or inside buildings shall be clear PVC.
Pipe located underground shall not be clear PVC. It shall be suitable for direct bury and installed to ASTM D2321 standards.

2.4 PRESSURE RATED FITTINGS

A. Product Fittings: Shall meet requirements of 2.3.A.

B. Containment Fittings: Shall meet requirements of 2.3.B.

2.5 UNLISTED COMPONENTS

A. Any special fittings, not supplied as part of the normal product offering, shall be classified as unlisted components. Products falling into this category shall be supplied by the manufacturer of the Double Containment System Only.

2.6 VALVES

A. Valve arrangements that are to be double contained shall be supplied pre-assembled and tested to 150% of the maximum operating pressures. Actuators, stem extensions, and other accessories shall be part of a pre-assembled package where appropriate.

2.7 PIPE SUPPORTS

A. Supports, guides, etc. for product pipe shall be provided of same resin as product pipe. Supports shall be placed in a manner that a maximum of 0.1" deflection is allowed between supports. Supports shall allow axial movement of product pipe within containment pipe. Supports shall

maintain a concentric relationship between product pipe and containment pipe. Supports shall be designed to allow the pulling of Leak Detection Cable through the pipe.

2.8 ANCHORS

A. Anchors shall be provided of same resin as product pipe and containment pipe. Anchors shall be of same wall thickness as product and containment pipe, and must be of unitary construction. Anchors shall be fully pressure rated. Anchors shall be Dogbone style by Asahi/America, Inc. Standard Dogbones shall be used for buried systems, while hung systems must use Restraint Dogbones.

2.9 FITTING SUPPORT DISKS

A. Support disks used to centralize fittings shall lock the product (carrier) fitting to the containment fitting. Free-floating fittings are not allowed. Support disks shall be designed to allow for flow and access cable in the annular space.

2.10 VENTS/DRAINS

A. High-point vents and low-point drains shall provide adequate flows to completely drain annular space. Vents/drains shall be located per contract drawings. Vents/drains shall be of same resin as product pipe.

2.11 ACCESS TEES

A. Shall be provided per contract drawings and per leak detection manufacturer's requirements. Access tees shall be of same resin as pipe.

2.12 DOUBLE CONTAINED FLANGES

A. All double contained flange connection shall consist of a double o-ring flange and a flat-faced flange. The flange design shall provide adequate flow of fluid through the annular space. All flanges shall be of the same resin as the pipe. Consult factory for pressure ratings on Double Contained Flanges.

2.13 IDENTIFICATION

A. Piping shall be identified by using self-adhesive pipe labels conforming to ASME 13.1 standards. Label shall either include arrows indicating flow direction or Contractor to utilize separate arrow banding. Pipe labels shall be as follows:
   1. "Sodium Hypochlorite" – Orange with Black lettering on piping from respective chemical storage tank fill and drain piping as well as from respective pump skid to injection points.
   2. "Dechlorination" – Orange with Black lettering on piping from respective chemical storage tank fill and drain piping as well as from respective pump skid to injection points.
   3. "Phosphate" – Orange with Black lettering on piping from respective chemical storage tank fill and drain piping as well as from respective pump skid to injection points.

B. Labels and arrow bands shall be placed on the outside of piping. Labels and arrows shall be placed on the outer piping of dual contained piping.

2.14 LEAK DETECTION

A. A visual leak detection system is required at minimum. If a visual system cannot be supplied a cable based leak detection system shall be installed. Leak detection is required in all double contained chemical lines from the remote fill box through to the day tanks. One leak detection system shall be supplied for each chemical.
B. Visual Leak Detection: All low point drains shall be of <1" in diameter. Contractor shall supply a bushing or reducer to incorporate into the system if not provided by double contained piping manufacturer. A short (approximately 3" dependent upon field conditions) spool piece shall be supplied and installed by Contractor, and installed prior to a manual ball valve supplied and installed by Contractor. The spool piece shall be constructed of clear schedule 40 PVC for visual leak detection.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install double-containment piping to comply with manufacturer's recommended procedures.

B. All Joining shall be done utilizing a two step process of primer and cement in accordance with ASTM D 2564.

C. Hot gas welding shall not be allowed for wetted components.

D. Manufacturer/Manufacturer's Representative shall be hired by installing firm for on-site training in the assembly, installation, and operation of double-containment systems.

3.2 TESTING

A. Testing shall be conducted in accordance with manufacturer's recommendations. The owner shall be notified at the time of test and choose to be present.

B. Pressure Systems
   1. Product Pipe: Should be tested hydrostatically to 150% of operating pressure per ASME B31.3 part 345 or per local code.

   2. Containment Pipe: To avoid moisture in the containment space, an air test shall be conducted on the containment pipe. Test pressure shall be 5 psi. The inner carrier pipe shall be full of water and under pressure during the air test to avoid any possible collapse of the product pipe.

3.3 SCHEDULES

A. The following minimum sizes shall be maintained for double-containment assemblies. Annular space must be maintained throughout the pipe, fittings, and all accessories.

Size	Carrier Schedule	Containment Schedule
1” x 3”	80	40
1” x 4”	80	40
1-1/2” x 4”	80	40
2” x 4”	80	40
2” x 6”	80	40
3” x 6”	80	40
4” x 8”	80	40

PART 4 - PAYMENT

4.1 All work required for the complete installation and satisfactory installation, including all labor, materials, equipment and specialties; guarantees; and other work as necessary to complete the work herein noted, otherwise called for, shown and/or required, shall be the responsibility of the Contractor.

4.2 Payment shall be made under the lump sum bid in the Proposal of that Contract, unless the work is specifically called for to be provided under another contract.

END OF SECTION 402400

SECTION 404213 – PROCESS PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The Contractor shall furnish and install piping insulation for all exterior and above ground process piping, fittings, and valves to prevent freezing.

B. This Section shall also include insulation of piping and valves supplied by third party manufacturers.

C. Contractor shall coordinate valve stem and instrumentation to ensure lengths take into account pipe insulation.

1.3 RELATED SECTIONS

A. Related Sections include the following:
   1. Division 22 and 23 Sections for plumbing and HVAC insulation respectively.
   2. Division 40 for pipe hangar insulation.

1.4 REFERENCES

A. ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers Inc. (ASHRAE): 90.1, Energy Standard for Commercial Buildings.

B. IECC: International Energy Conservation Code (IECC)

C. ICC: International Code Council. E96/E96M, Standard Test Methods for Water Vapor Transmission of Materials.

D. UL: Underwriters Laboratories Inc.

1.5 PERFORMANCE REQUIREMENTS

A. Insulation shall meet or exceed minimum thicknesses to prevent freezing.

1.6 SUBMITTALS

A. Product Data: For the following:

1. Descriptive information showing manufacturer, insulation type, and proposed thickness.
2. Manufacturer's installation instructions.

1.7 QUALITY ASSURANCE

A. Insulation shall meet the appropriate ASTM codes for material construction. The appropriate code shall be that which matches the insulation type.

B. Insulation shall be mold resistant.

PART 2 - PRODUCTS

A. Elastomeric Insulation

1. Material: Flexible elastomeric pipe insulation, closed-cell structure in accordance with ASTM C534/C534M.
2. Temperature Rating: Minus 297 degrees F to 220 degrees F.
3. Nominal Density: 3 pcf to 6 pcf.
4. Microban® or equivalent protection against mold.
5. Conductivity in accordance with ASHRAE 90.1 and maximum numerical value of 0.25 Btu-in./hr-square foot degrees F at 75 degrees F per ASTM C177 or ASTM C518.
6. Maximum water vapor transmission of 0.06 perm-inch per ASTM E96/E96M, Procedure A.
7. Joints: Manufacturer's adhesive.
8. Flame Spread Rating: Less than 25 per ASTM E84.
9. Smoke Developed Index: Less than 50 per ASTM E84.
10. Manufacturers and Products:
    a. Nomaco; K-Flex.
    b. Armacell; AP Armaflex.

B. INSULATION FINISH SYSTEMS

1. PVC:
    a. Polyvinyl chloride (PVC) jacketing, minimum 20 mils indoors and 30 mils outdoors, for straight run piping and fitting locations, temperatures to 140 degrees F.
    b. Color: PVC jacketing shall be color coded to match colors listed in pipe schedule where suitable matching colors are available. If no suitable colors are available jacketing shall be white.
    c. Flame Spread Rating: 25 per ASTM E84.
    d. Smoke Developed Index: 50 per ASTM E84.
    e. Manufacturers and Products:
        1) a. Knauf Insulation; Proto 1000.

2) b. Johns Manville; Zeston 2000 or 300.
3) c. Speedline; 25/50 Smoke-Safe.

PART 3 - EXECUTION

3.1 GENERAL

A. Insulate valve bodies, flanges, and pipe couplings.

B. Insulate and vapor seal hangers, supports, anchors, and other piping appurtenances that are secured directly to cold surfaces.

C. Do not insulate flexible pipe couplings and expansion joints.

D. Service and Insulation Thicknesses per the following table (Based on 45F water and 95F/95% RH air):

NPS (in)	Insulation Thickness (in) for Type Shown
	ASTM C 534 T1, Gr 1 Elastomeric
2	1.0
4	1.0
6	1.5
8	1.5
10	1.5
12	1.5
14	1.5
16	1.5
18	1.5
20	1.5
24	1.5

3.2 INSTALLATION

A. Install in accordance with manufacturer’s instructions and as specified herein.

B. Install after piping system has been pressure tested and leaks corrected.

C. Install over clean dry surfaces.

D. Use insulating cements, lagging adhesives, and weatherproof mastics recommended by insulation manufacturer.

E. Provide removal sections of insulation that cover nameplates or code inspection stamps.

F. Run insulation or insulation inserts continuously through pipe hangers and supports, wall openings, ceiling openings, and pipe sleeves, unless otherwise shown.

G. Install removable insulation sections on devices that require access for maintenance of equipment or removal, such as unions and strainer end plates.

H. Personnel Protection: Install on pipes from floor to 8 feet high. Install on pipes within 4 feet of platforms and to 8 feet high above platforms.

I. Placement:
   1. Insulate valves and fittings with sleeved or cut pieces of same material.
   2. Seal and tape joints.

J. Heat Traced Piping: Apply insulation after heat-tracing work is completed and inspected.

K. Vapor Barrier:
   1. Provide continuous vapor barrier at joints between rigid insulation and pipe insulation.
   2. Install vapor barrier jackets with pipe hangers and supports outside jacket.
   3. Do not use staples and screws to secure vapor sealed system components.

3.3 EQUIPMENT SUPPORTS

A. Apply coating of insulating cement where needed to obtain smooth and continuous appearance.

B. Where pipe labels or banding are specified, apply to finished insulation, not to pipe.

C. Painting Piping Insulation (Exposed to View):
   1. Color coded PVC jacketing does not require painting.

END OF SECTION 404213

SECTION 404213.1 – PROCESS HOT AIR PIPING INSULATION

PIPING INSULATION PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. The Contractor shall furnish and install piping insulation for all process piping, fittings, and valves to prevent condensation from forming on the process piping, fittings, or valves.

B. This Section shall also include insulation of piping and valves supplied by third party manufacturers.

C. Contractor shall coordinate valve stem and instrumentation to ensure lengths take into account pipe insulation.

1.3 RELATED SECTIONS

A. Related Sections include the following:
   1. Division 22 and 23 Sections for plumbing and HVAC insulation respectively.
   2. Division 40 for pipe hangar insulation.

1.4 REFERENCES

A. ASHRAE: American Society of Heating, Refrigerating and Air Conditioning Engineers Inc. (ASHRAE): 90.1, Energy Standard for Commercial Buildings.

B. Thermal insulation materials shall meet the property requirements of one or more of the following specifications as applicable to the specific product or end use:

C. American Society for Testing of Materials Specifications:

D. ASTM C 547, "Standard Specification for Mineral Fiber Pipe Insulation"

E. CAN/CGSB-51.9-92, “Mineral Fibre Thermal Insulation for Piping and Round Ducting”

F. ASTM C 585, "Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System)"

G. IECC: International Energy Conservation Code (IECC)

H. ICC: International Code Council. E96/E96M, Standard Test Methods for Water Vapor Transmission of Materials.

I. UL: Underwriters Laboratories Inc.

1.5 PERFORMANCE REQUIREMENTS

A. Insulation shall meet or exceed minimum thicknesses to prevent condensation from forming on piping and ancillaries.

B. Insulation materials furnished should meet the minimum thickness requirements of National Voluntary Consensus Standard 90.1 (1999), "Energy Efficient Design of New Buildings," of the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE). However, if other factors such as condensation control or personnel protection are to be considered, the selection of the thickness of insulation should satisfy the controlling factor.

C. Insulation materials furnished and installed hereunder shall meet the fire hazard requirements of applicable building codes when tested in composite form per one of the following nominally equivalent test methods:

1.	American Society for Testing of Materials	ASTM E 84
2.	Underwriters' Laboratories, Inc.	UL 723, CAN/ULC-S102-M88
3.	National Fire Protection Association	NFPA 255

1.6 SUBMITTALS

A. Product Data: For the following:

1. Descriptive information showing manufacturer, insulation type, and proposed thickness.
2. Manufacturer’s installation instructions.
3. Shop Drawings: Submit a list of insulation to be used for each service location.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the job site in factory containers with manufacturer’s label showing manufacturer, product name and fire hazard information.

B. Protect insulation from dirt, water, chemical attack and mechanical damage before, during and after installation.

C. Do not install insulation that has been damaged, wet or contaminated. Remove it from jobsite.

1. An exception may be allowed in cases where the contractor is able to demonstrate that wet insulation when fully dried out (either before installation or afterward following exposure to system operating temperatures) will provide installed performance that is equivalent in respects to new, completely dry insulation. In such cases, consult the insulation manufacturer for technical assistance.

1.8 PROJECTS AND SITE CONDITIONS

A. Maintain job site temperature and conditions before, during and after installation as required by the product manufacturer.

B. Installed insulation that has not been weatherproofed and is not protected by a roof and walls shall be protected from precipitation by weatherproof sheeting.

1.9 QUALITY ASSURANCE

A. Insulation shall meet the appropriate ASTM codes for material construction. The appropriate code shall be that which matches the insulation type.

B. Insulation shall be mold resistant.

C. Work shall conform to accepted industry and trade standards for commercial and industrial insulations and to manufacturer's recommendations.

D. Insulation shall be installed by skilled and experienced applicators who are regularly engaged in commercial or industrial insulation work.

PART 2 - PRODUCTS

2.1 MINERAL FIBER INSULATION

A. Thermafiber® Pro Section WR Type I, II, and IV, molded, for use up to 1200 degrees F (650 degrees C) by Owens Corning Insulating Systems, LLC or approved equal with the following characteristics:
   1. Complies with ASTM C547 Types I, II, and IV and Grade A and B.
   2. Furnished in standard lengths of 48 inches (1.22m) with square cut ends.
   3. Conforms to the dimensional requirements of ASTM C585.
   4. Rated maximum service temperature of up to 1200 degrees F (650 degrees C)
   5. Does not exceed 25 Flame Spread and 50 Smoke Developed when tested in accordance with ASTM E84, UL 723, CAN/ULC-S102.
   6. Certified to meet the requirements of ASTM C795 for use over stainless steel.
   7. Rated as noncombustible when tested in accordance with ASTM E136.

2.2 INSULATION FINISH SYSTEMS

A. Aluminum Jacketing
   1. Material: Type T-3003 H-14 sheet with either a smooth or embossed finish and a factory applied protective inner layer.
   2. Minimum Jacket Thickness: Insulation less than or equal to 8 inches outer diameter, 0.016 inches.
   3. Minimum Jacket Thickness: Insulation over 8 inches through 11 inches outer diameter, 0.020 inches.
   4. Minimum Jacket Thickness: Insulation over 11 inches through 24 inches outer diameter, 0.024 inches.
   5. Minimum Jacket Thickness: Insulation over 24 inches through 36 inches outer diameter,

0.032 inches.

6. Minimum Jacket Thickness: Insulation over 36 inches outer diameter, 0.040 inches.
7. Flame Spread Rating: 25 per ASTM E84.
8. Smoke Developed Index: 50 per ASTM E84.
9. Manufacturers and Products:
   a) Johns Manville
   b) Owens Corning

2.3 ACCESSORIES

A. Tie Wire: 16 gauge (1.6mm) or 18 gauge (1.8mm) Type 304 stainless steel.

B. Bands:
   1. 0.5 inches x 0.020 inches (13 x 0.5mm) type 304 stainless steel.
   2. 0.5 inches x 0.020 inches (13 x 0.5mm) T-3003 H-14 aluminum.

C. Screws: Galvanized or stainless steel sheet metal screws #6, #8 or #10 by 3/8 inches (10mm) long. Hex or pan head.

D. Adhesives: Compatible with mineral fiber insulation.

E. Weatherproofing: Compatible mastic.

PART 3 - EXECUTION

3.1 GENERAL

A. Insulate valve bodies, flanges, and pipe couplings.

B. Insulate and vapor seal hangers, supports, anchors, and other piping appurtenances that are secured directly to cold surfaces.

C. Do not insulate flexible pipe couplings and expansion joints.

3.2 EXAMINATION

A. Verify that materials and accessories can be installed in accordance with Contract Documents and material manufacturers' recommendations.

B. Verify, by inspecting product labeling, submittal data, and certifications which may accompany the shipments, that materials and accessories to be installed on the project comply with applicable specifications and standards and meet specified thermal and physical properties.

C. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.

D. Verify that testing of piping or tank has been completed and that the piping, tank and flat surfaces are ready for the insulation to be installed.

E. Verify that surfaces are clean, dry and free from dirt, scale, moisture, oil and grease prior to the insulation.

3.3 INSTALLATION

A. Install products in accordance with manufacturer's recommendations, approved submittals and in proper relationship with adjacent construction. Accessory materials shall also be installed in accordance with the current edition of the MICA “Commercial and Industrial Insulation Standards”, of the Process Industry Practices.

B. Piping shall be supported in such a manner that the insulation is not compromised by the hanger or the effects of the hanger.

1. Hanger spacing shall be such that the circumferential joint shall be outside the hanger.

C. Where pipe shoes and roller supports are required, insulation shall be inserted in the pipe shoe to minimize heat loss.

1. Where possible the pipe shoe shall be sized to be flush with the outer diameter of the pipe insulation.

D. Piping systems between 1.5 inches (38mm) and 3 inches (75mm) in diameter may be supported by placing saddles of the proper length and spacing under the insulation.

E. For piping systems larger than 3 inches (75mm) in diameter that operate at temperatures above 200 degrees F (93 degrees C), high density inserts shall be used underneath supports.

F. On vertical applications, insulation support rings shall be used with no more than 8 feet (2.44m) spacing between them or as indicated on contract drawings. The support ring shall be wide enough to support one half of the thickness of the outermost insulation layer.

1. Locate insulation and jacket seams out of sight where possible.

G. For piping and equipment operating at or above 600 degrees F (315 degrees C) or insulation thicknesses above 3 inches (75mm), use double layer insulation.

1. Stagger both longitudinal and circumferential joints to reduce the impact of the thermal expansion and contraction.

H. For single layer applications, circumferential joints shall be staggered.

1. Where long unbroken stretches of insulation are encountered, expansion joints may be required as noted on the contract drawings.

I. Insulation shall be firmly fastened in place with joints (longitudinal and circumferential) butted tightly and mechanically held in place using one, or a combination of the following materials:

1. 16 gauge (1.6mm) stainless steel wire. If the insulation is less than 12 inches (300mm) in diameter, 18 gauge (1.8mm) wire can be used.
2. 0.5 inches x 0.020 inches (13 x 0.5mm) stainless steel bands and clips.
3. Wire and bands shall be placed on maximum 12 inches (300mm) centers.

J. For piping systems placed 10 feet (3m) or more above the floor in mechanical equipment rooms or in finished spaces, metal jacket and fitting covers or approved equivalent is required.

1. Place jacket seams on the underside of the pipe.

K. Exterior applications and corrosive environments require metal jacketing.

1. When using metal jacketing in exterior applications: Butt joints and longitudinal overlaps shall be wide enough to provide weatherproofing.
2. Jacketing shall be secured using 0.5 inches (13mm) stainless steel bands on 12 inches (300mm) centers or using sheet metal screws on 4 inches (100mm) centers.
3. Place jacket seams such that water incursion cannot occur.

L. Maintain a vapor barrier by properly sealing joints, penetrations and other openings.

M. Seal valve stems with caulking to allow free movement of the stem but still provide a seal against moisture incursion.

N. Apply equipment insulation as smooth as possible by grooving, scoring and beveling insulation as necessary.

O. Bevel and seal the ends of insulation to equipment, flanges and piping.

P. Flanges, couplings and valve bonnets shall be covered with an oversized pipe insulation section sized to provide the same insulation thickness as the surrounding pipe sections.

1. Jacketing shall match that used on adjacent pipe.

Q. Rough cut ends shall be coated with a suitable weather or vapor resistant mastic as dictated by the system location and service.

R. On hot systems where fittings are to be left exposed, insulation ends shall be beveled away from bolts for easy access.

S. Fill joints, cracks and seams with mineral fiber or approved alternate.

T. Neatly finish insulation at supports, protrusions and interruptions.

U. Do not insulate over nameplates or ASME stamps. Form a tight insulation seal around them.

V. When equipment with insulation requires periodic opening for maintenance, repair or routine inspection, install the insulation in such a way that it can be easily removed and put back in place without damage.

3.4 FIELD QUALITY CONTROL

A. Upon completion of insulation work, visually inspect the work and verify that it has been correctly installed. This may be done while work is in progress, to assure compliance with requirements herein to cover and protect insulation materials during installation.

3.5 INSULATION PROTECTION

A. Replace damaged insulation which cannot be satisfactorily repaired.

3.6 SAFETY PRECAUTIONS

A. The insulation installers shall be properly protected during installation of the insulation. Protection when handling and applying insulation materials shall include but not be limited to: Disposable dust respirators, gloves, hard hats, and eye protection.

B. The insulation contractor shall conduct job site operations in compliance with applicable provisions given by OSHA as well as with state and local safety and health codes and regulations that may apply.

3.7 EQUIPMENT SUPPORTS

A. Apply coating of insulating cement where needed to obtain smooth and continuous appearance.

B. Where pipe labels or banding are specified, apply to finished insulation, not to pipe.

C. Painting Piping Insulation (Exposed to View):
   1. Insulation shall be painted the appropriate coded color to the type of pipe being insulated.

END OF SECTION 404213.1

SECTION 409123.23 - PARSHALL FLUMES (1”-84”)

PART 1 – GENERAL

1.1 SUMMARY

A. Parshall flume insert for flow measurement

1.2 RELATED SECTIONS

A. Section 033000 – Cast-In-Place Concrete

1.3 REFERENCES

A. ASTM D 638 – Standard Test Method for Tensile Properties of Plastics.

B. ASTM D 790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

C. ASTM D 1941-91(2001) – Standard Test Method for Open Channel Flow Measurement of Water with the Parshall Flume.

D. ASTM D 2583 – Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.

E. ISO 9826-92 – Measurement of Liquid Flow in Open Channel – Parshall and SANIIRI Flumes.

F. United States Department of the Interior, Bureau of Reclamation, Water Measurement Manual.

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 013300.

B. Product Data: Test results of representative fiberglass reinforced plastic laminate.

C. Shop Drawings: Show:
   1. Critical dimensions, jointing and connections, fasteners and anchors.
   2. Materials of construction.
   3. Sizes, spacing, and location of structural members, connections, attachments, openings, and fasteners.

D. Samples: 8-inch square sample of representative fiberglass reinforced plastic laminate.

E. Manufacturer's installation instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products indoors or in weather protected area until installation. Protect from construction traffic and damage.

PART 2 – PRODUCTS

2.1 MANUFACTURER

A. The product shall be manufactured by TRACOM, Inc.; 6575-A Industrial Way, O.A.E.

B. Warranty: Flumes shall be warranted to be free of defects in workmanship and materials for a period of two years from date of substantial completion.

2.2 PARSHALL FLUMES

A. Flume Type: Provide flumes of the following types:
1. Size: 24 INCH.

B. Construction:
1. Two-piece construction for field assembly, includes T-304 stainless steel connection hardware.

C. Materials:
1. Fiberglass reinforced plastic.
2. Gloss inside surfaces, free of irregularities.
3. Minimum 3/16 inch wall thickness.
4. Minimum 30% glass by weight.
5. Isophthalic polyester resin.
6. Removable pultruded fiberglass bracing at top of flume with T-304 stainless steel hardware.
7. 2 inch (minimum) top and end stiffening flanges.
8. Molded-in stiffening ribs, maximum 12 inch center to center spacing.
9. 15 mil Isophthalic U.V. resistant gel coat on all surfaces, white interior, grey exterior.
10. Anchor clips, pre-drilled with a 3/4 inch hole, pultruded fiberglass construction.
11. Tensile strength (ASTM D 638): 14,000 PSI.
12. Flexural strength (ASTM D 790): 27,000 PSI.
13. Flexural modulus (ASTM D 790): 1,000,000 PSI.
14. Barcol hardness (ASTM D 2583): 50.

D. Ultrasonic mounting bracket:

1. 2 inch NPT coupling for ultrasonic mounting bracket (bracket by others).

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that the flume dimensions and proposed elevationsare correct and project conditions are suitable for installation. Do not proceed with installation until condition deficiencies have been corrected.

3.2 INSTALLATION

A. Install products in accordance with engineer's instructions, plans, blueprints, etc.

B. Ensure that the product is installed plumb and that the upstream floor is level.

C. Set the flume at the elevation indicated on the engineer's drawings.

D. Embed the flume in concrete; pour concrete in maximum 6 inch lifts; internally line and brace the flume as necessary to ensure bowing or distortion does not occur.

3.3 ADJUST AND CLEAN

A. Clean surfaces in accordance with the manufacturer's instructions.

B. Remove trash and debris, and leave the site in a clean condition.

END OF SECTION 409123.23

SECTION 414010 - REMOTE FILL STATIONS

PART 1 – DESCRIPTION

1.1 WORK INCLUDED:

A. The Contractor shall furnish all labor, materials, and equipment necessary to provide functional remote fill stations.

1.2 RELATED SECTIONS:

A. See Section 402400 for chemical piping specifications.

1.3 SUBMITTALS:

A. The Contractor shall for review, provide six (6) sets of the following documentation:
   1. Remote station data sheet.
   2. Dimensional data.
   3. Bill of Materials

1.4 OPERATIONS AND MAINTENANCE DOCUMENTATION:

A. The system integrator shall provide two (2) sets of Operations and Maintenance documentation; all documentation shall be neatly bound in 3-ring binders.

1.5 WARRANTY:

A. The Contractor shall provide with the above submittals, a written parts and labor warranty against system failure for twelve (12) months from system startup, not to exceed eighteen (18) months from date of shipment from their factory. This warranty period will, with the exception of human negligence or acts of nature such as lightning, floods, wind etc., provide for repair of any and all defects of workmanship, as well as repair or replacement of any defective or failed components, at the project site, and at no cost to others.

1.6 QUALITY ASSURANCE:

A. The equipment covered in this specification section should be provided by a manufacturer with over ten (10) years experience with remote fill stations for chemicals.

PART 2 - PRODUCTS

2.1 Fill Station:

A. The station shall be Part No. TFS-WALL as manufactured by Wastech Controls & Engineering, Inc., 20600 Nordhoff Street, Chatsworth, CA 91311 Tel (818) 998 4939, www.wastechengineering.com; or approved equal.

B. Unit shall be mounted to either the concrete containment slab or building wall with stainless steel anchor bolts.

C. The interior piping shall have a 2" NPT quick disconnect coupling and ball valve. Both the coupling and valve shall be polypropylene, PVC, or other material compatible with Sodium Hydroxide and Sodium Hypochlorite. Stainless steel or brass piping material is not acceptable.

D. Box shall be vented and contain a minimum 7.5 gallon capacity sump within the unit connected to a drain pipe that will allow for complete draining in the event of a spill.

PART 3 - EXECUTION

3.1 Installation:

A. The contractor shall install equipment at locations indicated on the drawings.

B. Installation shall conform to the manufacturer's written instructions.

END OF SECTION 414010

SECTION 431133 – POSITIVE DISPLACEMENT ROTARY LOBE BLOWER PACKAGE

PART 1 – GENERAL

1.1 SUMMARY:

A. This section includes the furnishing and installation of equipment for the Positive Displacement Rotary Lobe Blower Package.

B. All equipment specified in this this section shall be designed and furnished by or through the blower manufacturer, who shall be responsible for the suitability and compatibility of all included equipment per this section.

C. Contractor shall Furnish, unload, store and install positive displacement blower equipment with accessories necessary to provide a complete operational system as shown on the plans and as specified.

D. Contractor shall be responsible for startup and training activities under the direction of the qualified manufacturer's representative.

1.2 SUPPLIER:

A. The blower equipment specified in this section shall be Kaeser Compressors, Inc. Model – DB 166 C or Acceptable Equal.

1.3 REFERENCE STANDARDS:

A. American Society of Testing and Materials (ASTM)

B. National Electrical Manufacturers Association (NEMA)

C. Occupational Safety and Health Act (OSHA)

D. National Electrical Code (NEC)

E. American Gear Manufacturers Association (AGMA)

F. Anti-Friction Bearing Manufacturers Association (AFBMA)

G. International Organization of Standardization (ISO)

H. International Electrotechnical Commission (IEC)

I. German Institute for Standardization (DIN)

1.4 SUBMITTALS:

A. Manufacturer's standard submittal for establishing compliance to this Section shall include the following items;
   1. Table of Contents
   2. A complete and detailed list of all variations to the specification.
   3. Descriptive literature, bulletins, and/or catalog cut sheets of the equipment.
   4. Scope of supply.
   5. Blower package performance data sheets showing at least the following:
      a. Package model name
      b. Bare blower model name
      c. Design conditions as listed in this section
      d. Air flow in ICFM and SCFM for design conditions listed
      e. Discharge pressure
      f. Motor size
      g. Brake horse power required for blower
      h. Bare blower speed with percentage of its maximum speed
      i. Process air connection size.
      j. Operating Voltage required for both main motor and enclosure ventilation fan.
      k. Sound pressure and power levels
      l. Dimensions
      m. Package weight
      n. Discharge temperature
      o. Accessories being supplied
   6. Installation data sheets.
   7. Manufacturer's standard performance curve showing blower rpm, pressure differential, capacity in ICFM, blower shaft horsepower, temperature rise at standard conditions.
   8. Blower package drawing showing all important details required for installation including dimensions, anchor bolt locations, size and location of connections to other works and weight of equipment.
   9. Motor manufacturer's data sheet showing at least the following:
      a. Motor manufacturer's name and model number
      b. Efficiency class and %
      c. Efficiency at ½, ¾, and full load
      d. Amp draw
      e. Motor RPM
      f. Code letter
      g. Motor frame
   10. Electrical connection diagram for motor, enclosure ventilation fan, and any blower accessory requiring an electrical connection.
   11. Inlet filter documentation.
   12. Data sheets for supplied instrumentation and accessories.
   13. Spare parts overview drawing.
   14. Recommend spare parts list.
   15. Paint specification for blower package.
   16. Maintenance overview.
   17. Blower startup check list.

18. Lubrication requirements.
19. SDS sheet (oil).
20. Warranty information.
21. Manufacturer's standard for equipment standards.
22. Compliance with Machinery Standards for sound and performance certificate.

B. Manufacturer's standard Operation and Maintenance Manual shall include the following sections:

1. Regarding this Document
2. Technical Data for the blower package
3. Safety and Responsibility
4. Design and Function
5. Installation and Operating Conditions
6. Installation
7. Initial Start-up
8. Operation
9. Fault Recognition and Rectification
10. Maintenance
11. Spare parts, Operating Materials, Service
12. Decommissioning, Storage and Transport
13. Annex with Drawings and Diagrams

1.5 QUALITY ASSURANCE

A. Manufacturers' Qualifications:

1. All equipment furnished under this section shall be manufactured in a plant whose quality management system is certified / registered as being in conformity with ISO 9001 and who shall assume complete responsibility for the design and performance of the blower package.
2. All equipment furnished under this section shall be new, unused, and shall be the standard product of the manufacturer, who shall have a minimum of 10 years' experience in producing blower packages and be able to produce evidence of at least 5 installations of similar size in satisfactory operation in the United States, if requested.

B. Factory Tests:

1. All cast parts to be manufactured in a plant whose quality management system is certified / registered as being in conformity with ISO 9001.
2. All critical dimensions of the blower components provided by the manufacturer shall be verified and documented prior to assembly.
3. On completion of final assembly of the packaged blower and prior to shipment, each blower package shall be mechanically run at the prescribed design conditions to confirm machine operation.
4. Each blower package provided by the manufacturer shall be guaranteed to provide performance to ISO 1217, Annex C.

1.6 PRODUCT DELIVERY, HANDLING, AND STORAGE

A. Delivery and Handling of Equipment:

1. Manufacturer and Contractor shall coordinate the delivery schedule for just in time delivery to minimize the period the Blower package is on site before installation.
2. Contractor shall unload and inspect all equipment and materials against reviewed shop drawings at the time of delivery. Any damage shall be reported to the freight company immediately upon receipt.
3. Equipment and materials damaged or not meeting the requirements of the reviewed shop drawings shall be immediately returned for replacement or repair.
4. Each box or shipping crate shall be properly marked to show its net weight and its contents.

B. Storage:

1. Contractor shall prepare for storage and label all equipment and materials after they have been inspected. The Contractor shall be responsible for the equipment and materials while in storage.
2. Store materials to permit easy access for inspection and identification. Support all material off of the ground while protecting steel members and packaged material from corrosion and deterioration as per manufacturers' instructions.

1.7 SPARE PARTS

A. Furnish the following manufacturer's recommended routine maintenance spare parts for each blower package provided:

1. Two (2) integral inlet silencer filter elements
2. Lubrication for first year of operation
3. One (1) belt set
4. One (1) tube of motor grease (50HP or larger)

B. All parts shall be furnished in clearly identified packaging.

1.8 WARRANTY

A. The manufacturer shall warrant the bare blower being supplied against all defects in workmanship and materials for a period of sixty (60) months from date of startup, not to exceed sixty-six (66) months from date of shipment from the manufacturer of the blowers. All other package components shall be warranted for a period of twelve (12) months from date of startup, not to exceed eighteen (18) months from the date of shipment.

B. The contractor shall be responsible for proper storage of the equipment so as to remain in "as shipped" condition. If the equipment remains in storage at the job site for longer than six (6) months before installation, the contractor shall provide factory service personnel for a complete inspection of the equipment. Any work necessary to restore the equipment to "as shipped" condition shall be the responsibility of the contractor.

PART 2 – MATERIALS

2.1 MANUFACTURER:

A. The equipment specified herein is intended to be standard equipment for use in low pressure air systems and be supplied by a single manufacturer or authorized sales representative to assure uniform quality, ease of maintenance, and minimal parts storage.

B. Manufacturer List:
   1. Kaeser Compressors, Inc.
      i. Model – DB 166 C
   2. or Acceptable equal

C. Plan layouts, weights, and pertinent specification language used in the design have been based upon Kaeser Compressors, Inc. equipment. Any changes required to accommodate equipment other than the basis of design shall be provided by the Contractor at no additional expense to the Owner. Furthermore, a complete and detailed deviation list from the specification shall be provided with proposal.

2.2 DESIGN CRITERIA

A. Standard Conditions for SCFM:
   1. Elevation: 14.7 PSIA (0’ elevation)
   2. Temperature: 68 deg F.
   3. Relative Humidity: 36%

B. Design (site) Conditions for ICFM:
   1. Elevation: 14.7 PSIA (14’elevation)
   2. Maximum Blower Inlet Temperature: 95 deg F.
   3. Relative Humidity*: 60% *Relative humidity at maximum blower inlet temperature.

C. Performance Data:
   1. Application: POST AERATION BASIN
   2. Quantity: 2 (1 for redundancy)
   3. Blower Packaged Controlled by a VFD: YES
   4. Flow required: 409 SCFM
   5. Blower Package Discharge Pressure: 19.4 PSI
   6. Motor Horsepower: 20 HP
   7. Motor shaft power shall account for belt losses in addition to internal package losses.
   8. The motor shall not operate in its service factor at design conditions.
   9. VFD efficiency loss shall be accounted for.
   10. Power supply voltage:
      a. Main motor: 460v/ 3ph/ 60hz
      b. Enclosure ventilation fan motor: 115v/ 1ph/ 60hz
   11. % of Maximum Blower Speed at 60hz: 89%
   12. Blower Package Sound Level: 87 dB(A) at 3 feet* In accordance with ISO 2151, +/- 3 dB(A) at 1m, free field conditions, with insulated piping.

2.3 BARE BLOWER CONSTRUCTION

A. Blower Type:
   1. The bare blower shall be mounted for vertical air flow, be of the oil-free, positive displacement, rotary three lobe type, designed for air or other inert gas service, and belt driven via electric motor.
   2. The bare blower assembly must operate at the effective value for vibration velocity in frequency range A and B, according to VDI 3836.

B. Material:
   1. AISI, ASTM, GJL, GLS, DIN, etc., numbers, types, and grades specified are typical of material composition and quality, equivalent materials will be considered.

C. Housing:
   1. The casing shall be made of high strength, close grained, cast iron, and shall be adequately ribbed to prevent casing deflection and facilitate cooling. Casing shall be of EN GG 20 material.
   2. The casing shall be precision machined to allow for minimum clearances.
   3. The casing shall include channels integrated on the discharge to reduce blower pulsation and dampen noise.
   4. The casing shall include threaded atmospheric vent ports between its air-side and oil-side labyrinth seals for safe separation of the conveying and oil chamber.
   5. Inlet and discharge ports shall be drilled and tapped for studs to allow solid connection of mating surfaces. Through bolting shall not be allowed. Flange style blower ports, which may be subject to loading, causing cylinder distortion, shall not be allowed.
   6. Bearing fits shall be precision machined to ensure accurate positioning of the rotors in the casing.

D. Rotors:
   1. The rotors shall be precision machined out of a one piece casting made of EN GGG 50 material. Stub shafts or two-piece impellers shall not be allowed.
   2. The rotor assemblies shall be statically and dynamically balanced to ISO standard 1940/1-Q2.5 (turbine rotor). Modifications to the face of the rotors for balancing purposes are not acceptable.
   3. The rotors shall be a tri-lobe design in order to minimize pulsation and noise.
   4. The rotor must be solid or closed-end to prevent build-up of contaminants inside the rotor causing imbalance.
   5. Cored rotors must be closed using threaded iron plugs which are permanently fixed. Impeller end caps of stamped sheet metal shall not be allowed.
   6. The rotors shall have an integral sealing strip for improved efficiency.
   7. The rotors shall operate without rubbing, liquid seals or lubrication in the air chamber.

E. Cover Plates:
   1. The gear-end and drive-end cover plates shall be high strength, close grained, cast iron made of EN GG 20 material. Aluminum cover plates shall not be allowed.
   2. The cover plates shall have a precision machined sealing face.
   3. The drive-end cover plate shall include at least two precision machined holes to allow for the use of fitting bolts to accurately align the opening for the input shaft seal.

F. Timing Gears:
   1. The rotor timing gears shall be precision machined and ground from alloy steel made from case hardened 16 MnCr5 material.
   2. Each timing gear shall be straight cut and beveled to quality standard 5f 21, which will eliminate axial bearing loads and ensure long life as well as quiet operation. Helical gears, which cause axial loading, shall not be allowed.
   3. Each timing gear shall be manufactured in accordance with:
      a. DIN 3960, Specifications for Spur Gear Sets
      b. DIN 3961 & DIN 3962, Tolerances for Spur Gear Mesh
      c. DIN 3964, Specifications for Shaft Centering
   4. The timing gear set shall be taper-mounted on the rotors. Keyed, hub mounted, taper-pinned, or splined shaft timing gear mounting designs are not acceptable.

G. Bearings:
   1. All four rotor shaft support locations shall incorporate large, heavy-duty, full complement, cylindrical roller bearings with PEEK cages, designed with at least 5-times the dynamic capacity of ball bearings. Ball bearings shall not be allowed.
   2. The bearing maximum speeds must be at least two times the maximum recommended blower speed.
   3. The bearings minimum acceptable L10 design life shall be as follows;
      a. At least 40,000 hours at blower's maximum rated speed and maximum rated differential pressure.
      b. At least 100,000 hours at design conditions.

H. Lubrication:
   1. Both the gear end and the drive end of the blowers shall be oil splash lubricated via a disc slinger for minimal maintenance and long service life. Grease lubricated bearings in the blower are not acceptable.
   2. The lubrication design shall ensure adequate lubrication of the timing gears and bearings.
   3. The drive-end and gear-end oil chambers must not be interconnected and each oil chamber shall have a domed design sight glass to allow visual inspection of oil level and oil condition, viewable from the front of the blower.
   4. Blower to be factory filled with a synthetic lubricating fluid that is rated for the design conditions specified.

I. Rotor Seal Assembly:
   1. Each rotor shall include one labyrinth seal assembly on each end, four assemblies in total per blower. Each seal assembly shall consist of the following;
      a. Oil splash guard ring.
      b. Shaft guide wear sleeve with vent holes located between the dual air and oil ring seals. Wear sleeve shall protect the blower casing.
      c. Four piston ring type labyrinth seals made from heat treated GG/42CrMo4 material. Two seals located on the air side and two seals located on the oil side of the grooved rotor sleeve. The use of rubber lip seals shall not be allowed.
      d. Grooved rotor sleeve which will protect the rotor shaft and be used to hold the four piston ring seals.

J. Input Shaft Seal Assembly: (Compak BBC, CBC, DBC, and EBC series)
   1. The input drive shaft seal shall be a high temperature radial lip type seal made from Viton elastomer. The seal shall prevent oil leakage from where the input shaft goes thru the drive end cover.

2. The seal design shall incorporate a replaceable wear sleeve on the input drive shaft.
3. The sleeve exterior to be tungsten carbide coated to reduce friction and wear.
4. The input shaft seal design must allow for the lip seal and the shaft sleeve to be replaced without removing the drive end cover plate.

2.4 BLOWER PACKAGE CONFIGURATION

A. Installation Location: Outside

B. Inlet Configuration: Ambient

2.5 MOTORS:

A. Drive Motor:
1. Motor shall be designed, manufactured, and tested in accordance with the latest revised editions of NEMA MG-1, IEC, DIN, ISO, IEEE, ANSI, and AFBMMA standards as applicable and shall be capable of continuous operation.
2. Motor must meet or exceed Energy Independence and Security Act (EISA 2007) standards for NEMA Premium efficiency. It shall also be marked with a Department of Energy Certification Compliance Number to assure compliance.
3. Motor shall comply with Low Voltage Directive 2006/95/EC or equivalent and be UL listed.
4. Motor must be inverter rated with impulse peak resistance in accordance with IEC 60034-1:2010 or equivalent for operation with an IGBT frequency converter or equivalent.
5. Motor horsepower nameplate rating shall not be exceeded at the design discharge pressure when operating at 60hz.
6. The temperature rise of the motor windings shall not exceed IEC and NEMA standards when the motor is operated continuously at the rated horsepower, rated voltage, and frequency in ambient conditions at 104ºF / 40ºC.
7. Motor shall be suitable for Full Load/Direct On-line starting, Solid State Ramp starting, VFD, and/or Wye-Delta reduced current starting.
8. Motor to be supplied, mounted and aligned by the blower package manufacturer.
9. VFD controlled motor (=>75HP) shall have an isolated non drive end “B-side” bearing.
10. Motor shall confirm to the following:
    a. Motor voltage: 460v/ 3ph/ 60hz
    b. Type: Squirrel cage induction
    c. Speed: Single
    d. Torque: Constant
    e. Service factor: 1.15
    f. Enclosure: TEFC
    g. Mounting: Horizontal
    h. Speed: up to 3,270 rpm @ 60 hz (maximum)
    i. Design: A
    j. Duty cycle: continuous (24 hours a day)
    k. Winding insulation: F
    l. Temperature rise: B
    m. Thermal motor protection: Positive Temperature Coefficient (PTC) thermistors (one per winding) wired in series. The use of thermostats is not allowed

1. Connection of the PTC thermistors to the control system and signal processing is not part of the blower manufacturer's scope of supply.

n. Conduit box location: Top

o. Wiring Connection: Terminal strip inside conduit box. Use of wire nuts for connection of motor wiring to power source shall not be allowed.

p. Bearing L10 life: >40,000 hours

q. Bearing lubrication: Grease

r. Bearing type:

1. ≤ 40HP: Permanently greased

s. Bearing design: Cantilever forces (belt drive)

t. Condensation winding 110v heater: No

11. Motor shall be as manufactured by Siemens.

12. Connection and control of the drive motor to the control system is not part of the blower manufacturer's scope of supply

B. Sound Enclosure ventilation fan motor

1. Motor voltage: reference Performance data – Power supply voltage

2. Motor shall be UL listed

3. Motor starter/ overload protection is the responsibility of the control system provider.

4. The fan motor should turn "on" when the main motor starts and turn "off" 10 minutes after the main motor stops. Controlling the fan motor via a thermostat shall not be allowed.

5. Connection and control of the fan motor to the control system is not part of the blower manufacturer's scope of supply

2.6 BLOWER PACKAGE

A. Drive:

1. The blower shall be driven by the drive motor through a V-belt drive assembly designed to meet the blower conditions specified with a 1.2 or larger service factor.

a. V-belts shall have a XPZ/XPB profile with embedded low-stretch polyester tension cords. The v-belts shall be designed for high rotational speeds and be heat and oil resistance. Ribbed, banded, or multi groove belts shall not be allowed.

b. Sheaves shall have a SPZ/SPB profile and be balanced to G16 for below 30m/s and G6.3 for sheaves above 30m/s.

c. Keyed taper bushing shall be used for easy installation and removal. QD type bushings shall not be allowed.

2. The blower drive must have a fully enclosed guard which protects the operator when the blower package enclosure is open while in operation.

a. Belt guard shall be OSHA approved.

b. The belt guard made from the manufacturer's standard sheet metal, shall be designed to duct the cooling air flow from the drive motor fan across the front of the blower to supplement blower input shaft seal cooling.

c. The mounting fasteners for the belt guard shall be retained on the housing to prevent loss during maintenance.

3. Belt tension shall be accomplished by the use of a motor swing base and automatic tensioning assembly.

a. The drive motor shall be mounted on a pivoting swing base with an axial adjustment for proper alignment of the v-belts. The weight of the drive motor shall provide the primary belt tension. The use of a sliding motor mount shall not be allowed.

b. A tensioning assembly consisting of a threaded rod with spring shall be used to adjust the v-belt tension to prevent belt slippage and efficiently transmit power to the blower. It shall include a visual indication showing whether or not the v-belt tension is within the correct belt tension range.
c. Adjustment of the tensioning assembly shall be accomplished without removal of the guard or loosening of the motor mounting bolts.
d. The design of the swing base with tensioning assembly shall prevent the swing base from falling and creating a personnel hazard in the event of a belt failure. The tensioning assembly adjusting nut shall raise the motor swing base facilitating v-belt changes without the use of pry bars or jacks.

B. Inlet Silencer
1. An inlet silencer designed for the frequency range of the blower, shall be provided to reduce the noise of the blower package as specified.
a. The inlet silencer shall be of carbon steel construction and be of the wear-free absorptive type, directly connection to the inlet port of the blower, and shall be mounted horizontally.
b. The inlet silencer shall be lined with replaceable polyether absorptive material.
c. The inlet silencer shall have an integral filter designed to protect the blower from particulates. It shall be located between the absorptive material and the blower inlet.
1. The filter element shall be a washable and reusable polyester element for minimal pressure drop.
2. The filter efficiency shall meet ASHRAE 52.2 MERV7 50-70% @ 3-10 microns corresponding to EN779 G4.
3. The filter element integral to the silencer shall be supplied no matter if the inlet configuration of the silencer is ambient or piped. If required on piped inlet configuration, any additional filtration or screening at the inlet location of the piped inlet air source is not the responsibility of the blower manufacturer.
4. Filter element shall be removable without disconnecting the inlet duct.
d. The filter maintenance cover and element must be removable by hand (without the use of tools).
e. The pressure loss thru the inlet silencer assembly shall be accounted for in the motor horsepower selection of the blower package.

C. Base frame with integrated discharge silencer:
1. The blower base frame with integrated discharge silencer shall be designed for the frequency range of the blower, shall be provided to reduce the noise of the blower package as specified.
a. The blower base frame shall be of formed steel construction and designed for horizontal mounting of blower with vertical air flow. Flange-mounting only of the bare blower to the blower base frame shall not be allowed, additional support by use of the base frame shall be required; preventing the loading of the blower casing and discharge silencer shell.
b. The blower base shall incorporate the pivoting motor swing base and tensioning assembly to insure proper alignment of the drive assembly.
c. The discharge silencer shall be an integral part of the base frame.
d. The discharge silencer type shall be a combination of absorption, reflection and diffusion.

1. The design of the discharge silencer shall incorporate a solid outer and perforated inner cylinder with absorptive material in between the cylinders.
    a. Absorptive material shall be long, flexible, knotted polyester fibers to allow for lowering the noise and heat emissions inside the sound enclosure. The use of mineral wool shall not be allowed.
2. The discharge silencer shall have connections ports for pressure relief, discharge pressure, and discharge temperature. Unused ports shall be capped or plugged.

e. The pressure loss thru the discharge silencer assembly shall be accounted for in the motor horsepower selection of the blower package.

D. Blower Sound Enclosure:

1. A sound enclosure shall be provided which fully covers the blower, motor, drive assembly, inlet silencer, blower base frame with integrated discharge silencer, and be shipped fully assembled.
    a. The sound enclosure shall be the product of the blower manufacturer to insure proper integration of blower package components.
    b. The sound enclosure shall meet the sound level specified.
    c. The sound enclosure acoustic material shall comply to FMVSS 302 with a burning rate B or lower than 100 mm/min.
    d. The sound enclosure assembly shall be of self-supporting bolted steel panel construction on a fabricated steel skid.
        1. All maintenance removable panels or doors shall be located in the front of the sound enclosure and must have a slotted key lock. A door key shall be provided. All maintenance panels shall meet OSHA weight requirements.
        2. The enclosure base shall be designed to enclose the full bottom of the sound enclosure and include fork lift guides for easy transportation and installation.
    e. The sound enclosure ventilation cooling air circuit shall be separate from the process air circuit. Mixing of the two air circuits within the enclosure shall not be allowed.
    f. The sound enclosure shall have a set of inlet louvers positioned on the blower-side of the enclosure to allow for the flow of ambient cooling air across the blower oil sumps.
    g. A screened inlet louver shall be located on the back of the enclosure and designed to provide a laminar flow of ambient cooling air across the blower drive motor.
    h. The sound enclosure ventilation air exhaust and the ventilation fan shall be located at the top of the sound enclosure.
        1. The ventilation fan shall be sized to provide adequate cooling of the blower package at all blower speeds.
        2. The ventilation fan voltage shall be as specified and run concurrent with the main motor. The ventilation fan shall not be controlled by a thermostat.
    i. The back of the sound enclosure shall have predrilled holes with grommets for easy pass-thru of electrical wiring.
    j. When installed outdoor, reference Blower Package Configuration Part 2.4. An outdoor stainless steel weather hood shall be installed on top of the enclosure to protect the unit from the elements. The weather hood shall be designed to allow access to the sound enclosure and panel mounted instruments.

E. Blower Package Accessories:
   1. Pressure Relief Valve
      a. The relief valve(s) shall be factory installed within sound enclosure. Relief valve may not be shipped loose for field installation in the discharge piping.
      b. The relief valve(s) shall be spring type and must be sized for 100% of the design flow specified. Weighted relief valves shall not be used.
      c. The relief valve(s) shall be set to protect the blower from excessive differential pressure based on the design conditions specified. A seal shall be affixed that must be broken if set point is changed.
      d. The relief valve(s) exhaust shall be vented out of the sound enclosure. Exhaust vented into the sound enclosure shall not be allowed.
      e. The relief valve shall be ASME Section VIII, UV, CE, and PED certified.
      f. The relief valve shall be manufactured by Kunkle.

   2. Check Valve
      a. A check valve to prevent back flow through the blower shall be factory installed and not shipped loose for field installation in the discharge piping.
      b. The check valve flapper shall be swing type made from a steel disc embedded in a high temperature silicone elastomer. The valve shall be designed so that, in the event of failure, the valve element is retained in the valve housing. Split disc or center hinged designs shall not be used.
      c. The check valve capacity shall exceed the blower package's maximum discharge pressure and temperature.
   3. Flexible Connector
      a. An elastomeric compensator/flex connector shall be provided to isolate the connection of the blower package to the self-supporting system piping. Restraining rods shall not be used. Flex connectors located between the bare blower and silencers shall not be allowed.
      b. The flexible connector capacity shall exceed the blower package's maximum discharge pressure and temperature.
      c. Discharge connection
         1. 4" and smaller connection, a web reinforced silicone rubber sleeve with corrosion resistant clamps shall be provided. (Compak BBC, CBC, and DBC series)
      d. Piped Inlet connection – When required, Reference Blower Package Configuration 2.3.
         1. 6" or smaller connection, a web reinforced silicone rubber sleeve with corrosion resistant clamps shall be provided. (Compak BBC, CBC, DBC and EBC series)
   4. Blower instrumentation gauges
      a. The following gauges shall be pre-piped and panel mounted on the front of the sound enclosure. Gauges shall not be shipped loose for field installation.
      b. Discharge pressure gauge
         1. The discharge pressure gauge shall measure the pressure at the discharge of the blower.
         2. The discharge pressure gauge shall be dual unit (English – PSI / Metric – Bar) with a range of 0 – 23 psi (0 – 1.6 bar). Minimum dial diameter shall be 2 ½", made with a stainless steel case and be glycerin filled for pulsation dampening.
      c. Discharge temperature gauge with adjustable switch

1. The discharge temperature gauge shall measure the temperature at the discharge of the blower package.
2. The discharge temperature gauge shall be dual unit (English - ºF / Metric - ºC) with a range from 32 – 392ºF (0 – 200ºC) and include an adjustable set point dial. Minimal dial diameter shall be 2 ½", made with a black plastic case and have a liquid filled measuring system that is converted by a Bourdon tube into a rotary movement of the pointer. The rotary movement of the pointer spindle shall operate a SPDT microswitch through a lever system. Voltage rating up 220v, 5amps.
3. The high temperature set point shall be as recommended by the blower manufacturer.
4. Connection of the switch to the control system is not part of the blower manufacturer's scope of supply. The switch shall be wired to shut down the blower package when actuated.

d. Filter differential pressure gauge
1. The filter differential pressure gauge shall measure the pressure difference from ambient to the back side of the filter that is integral to the blower package's inlet silencer. When the filter starts to become dirty, the resistance shall be shown on a resettable red dial indicating when the filter shall be changed.

5. Oil Drains
a. An oil drain from the blower drive-end and gear-end lubricating oil sumps shall be separately piped to the front of the blower base with flexible tubing. Common fill and drain shall not be allowed.
b. Each oil drain shall include a drain valve installed for ease of maintenance. The drain valves shall be 90° nickel plated brass valves and include a fully retained gasketed threaded cap to prevent accidental discharge of the blower lubricant.

6. Vibration isolators
a. Vibration isolators shall be provided between the base frame with integrated discharge silencer and sound enclosure skid to prevent transmission of vibration to the foundation.
b. A ground wire shall be installed between the blower base and the sound enclosure base to allow for grounding of the complete blower package.

7. Discharge pressure switch
a. The blower package shall include an installed discharge pressure switch that shall measure discharge pressure of the blower.
b. The discharge pressure switch shall be field adjustable.
c. The discharge pressure switch shall be a SPDT switch, Voltage rating up to 250v, 1A
d. Connection of the switch to the control system is not part of the blower manufacturer's scope of supply. The switch shall be wired to shut down the blower package when actuated.

8. Enclosure Heater Assembly
a. The blower package when installed where temperatures could be between 5 to 23º F shall include an installed 115v/1ph/60hz enclosure heater with a thermostatically controlled switch that shall heat the inside of the enclosure.
b. The enclosure heater switch shall be field adjustable and be factory set to come on at 41 deg F (5 deg C).
c. Connection of the enclosure heater system to the control system is not part of the blower manufacturer's scope of supply.

9. Instrumentation junction box

a. The blower package shall include an instrumentation junction box where all the provided instrumentation is wired to a terminal strip making for a central electrical connection point (except for the main blower drive motor).
b. Connections from the instrumentation junction box to the control system are not part of the blower manufacturer's scope of supply.

F. Nameplates:
1. The blower package shall have at least two weather proof corrosion resistant type nameplates which includes the manufacturer name, model number, year, max pressure difference, equipment number, part number, serial number, voltage, phase, HP, motor rpm, rated temperature, and FLA attached on the outside and inside of the blower package.

G. Anchor bolts and hardware:
1. Anchor bolts, washers, hex nuts, and all other fastening hardware shall be stainless steel and be supplied by the contractor.

H. Paint Specification:
1. The blower manufacturer is responsible for surface preparation, priming and finish coating of the blower package and components requiring paint in accordance with the manufacture's standard procedures. Field painting of blower equipment or supplying components that are only prime painted is not acceptable.
a. Cast parts are to be painted with a two part gray epoxy primer and two part top coat.
b. Fabricated parts are to be painted with a two part gray epoxy primer and two part top coat.
c. Sound enclosure parts are to be powder coated.
1. Panels and base paint finish shall be pretreated by de-greasing and phosphate cleaning, then powder coated to a thickness of 70 µm -100 µm on both sides.
2. The blower package to be painted the blower manufacturer's standard colors.

PART 3 – EXECUTION

3.1 Installation

A. The blower package shall be handled and installed in accordance with the manufacturer's recommendations and instructions as shown in the location on the drawings.
B. Contractor shall field verify all dimensions and elevations. The engineer shall be notified of any specific differences.
C. The blower package shall arrive on site ready for installation. Aligning, adjusting and filling the blower with lubrication shall not be required by the contractor.

3.2 Field Quality Control

A. Furnish the services of a manufacturer's authorized representative for a minimum of one 8 hour day for proper installation to inspect and approve the installation, and to supervise a test run of the blower package.
B. After the installation and test run has been completed; the blower package shall be given a field test in the presence of the Engineer to verify that operation is satisfactory and in compliance with the Specification. If the blower package does not meet the Specification, corrective measures shall be taken to ensure the machine meets compliance.

3.3 Training

A. Furnish the services of a manufacturer's authorized representative, who will instruct plant personnel in the operation and maintenance of the blower package. All procedures shall be covered including preventive maintenance, method of controlling the blower package and troubleshooting. The training sessions shall be provided for a minimum of one 8 hour day.

END OF SECTION 431133

SECTION 432313.27 – PRIMARY SLUDGE PUMPS (HORIZONTAL SELF-PRIMING CENTRIFUGAL PUMP)

PART 1 - GENERAL

1.1 SCOPE:

A. Under this item, the contractor shall furnish and install into operation the following;

1. (2) two horizontal self-priming centrifugal pumps and all appurtenances as specified below. These pumps shall be installed in the Primary Sludge Pit as indicated on the plans.
2. The manufacturer shall provide complete simplex control panels and control instrumentation for each pump.

1.2 PERFORMANCE CRITERIA

A. The pump manufacturer must be ISO 9001:2008 revision certified, with scope of registration including design control and service after sales activities.

B. The pump manufacturer must be registered to the ISO 14001 Environmental Management System standard and as such is committed to minimizing the impact of its activities on the environment and promoting environmental sustainability by the use of best management practices, technological advances, promoting environmental awareness and continual improvement.

C. Pumps must be designed to handle raw, unscreened, domestic sanitary sewage. Pumps shall have 3" suction connection, and 3" discharge connection. Each pump shall be selected to perform under following operating conditions:

1.	Capacity (GPM)	_____200____
2.	Total Dynamic Head (FT)	_____15_____
3.	Minimum TDH (FT)	_____11_____
4.	Maximum TDH (FT)	_____30_____
5.	Total Discharge Static Head (FT)	_____20_____

D. Pump Performance Certifications

1. Solids Handling Capability

a. All internal passages, impeller vanes, and recirculation ports shall pass a 2.5" spherical solid. Smaller internal passages that create a maintenance nuisance or interfere with priming and pump performance shall not be permitted. Upon request from the engineer, manufacturer's certified drawings showing size and location of the recirculation port(s) shall be submitted for approval.

E. Reprime Performance

1. Consideration shall be given to the sanitary sewage service anticipated, in which debris is expected to lodge between the suction check valve and its seat, resulting in the loss of the pump suction leg, and siphoning of liquid from the pump casing to the approximate center line of the impeller. Such occurrence shall be considered normal, and the pump must be capable of automatic, unattended operation with an air release line installed.
2. During unattended operation, the pump shall retain adequate liquid in the casing to insure automatic repriming while operating at its rated speed in a completely open system. The need for a suction check valve or external priming device shall not be required.

3. Pump must reprime 10 vertical ft. at the specified speed and impeller diameter. Reprime lift is defined as the static height of the pump suction above the liquid, while operating with only one-half of the liquid remaining in the pump casing. The pump must reprime and deliver full capacity within five minutes after the pump is energized in the reprime condition. Reprime performance must be confirmed with the following test set-up:

    a. A check valve to be installed down stream from the pump discharge flange. The check valve size shall be equal (or greater than) the pump discharge diameter.
    b. A length of air release pipe shall be installed between pump and the discharge check valve. This line shall be open to atmosphere at all times duplicating the air displacement rate anticipated at a typical pump station fitted with an air release valve.
    c. The pump suction check valve shall be removed. No restrictions in the pump or suction piping will prevent the siphon drop of the suction leg. Suction pipe configuration for reprime test shall incorporate a 2 feet minimum horizontal run, a 90^{o} elbow and vertical run at the specified lift. Pipe size shall be equal to the pump suction diameter.
    d. Impeller clearances shall be set as recommended in the pump service manual.
    e. Repeatability of performance shall be demonstrated by testing five consecutive reprime cycles. Full pump capacity (flow) shall be achieved within five minutes during each cycle.
    f. Liquid to be used for reprime test shall be water.
    g. Upon request from the engineer, certified reprime performance test results, prepared by the manufacturer, and certified by a registered professional engineer, shall be submitted for approval prior to shipment.

F. Certified Pump Performance Test

1. Tests shall be conducted in accordance with Hydraulic Institute Standards 14.6.3.4 Acceptance Grade 2B at the specified head, capacity, rated speed and horsepower. The performance tests will validate the correct performance of the equipment at the design head, capacity and speed.

2. For pumps utilizing up to (13 HP) motors; but larger than (1.3 HP), tests shall be conducted in accordance with Hydraulic Institute Standards 14.6.3.4.1, as the specified head, capacity, rated speed and horsepower.

3. Components failing to perform as specified by the engineer, or as represented by the manufacturer, or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer.

4. It is not intended that the pump manufacturer assume liability for consequential damages or contingent liabilities arising from failure of any vendor supplied product or part which fails to properly operate, however caused. Consequential damages resulting from defects in design, or delays in delivery are also beyond the manufacturer's scope of liability.

5. This limited warranty shall be valid only when installation is made and use and maintenance is performed in accordance with manufacturer recommendations. The warranty shall become effective on the date of acceptance by the purchaser or the purchaser's authorized agent, or sixty (60) days after installation, or ninety (90) days after shipment from the factory, whichever occurs first.

1.2 SUBMITTALS:

A. Submittal data shall be provided to show compliance with these specifications, plans or other specifications that will influence the proper operation of the pump(s).

B. Standard submittal data for approval must consist of:

1. Pump Performance Curves.
2. Pump Outline Drawing.
3. Electrical Motor Data.
4. Typical Installation Guides.
5. Technical Manuals and Parts List.
6. Printed Warranty.
7. Management system certificate ISO 9001.
8. Manufacturer's Equipment Storage Recommendations.
9. Manufacturer's Standard Recommended Start-Up Report Form.

C. Lack of the above requested submittal data is cause for rejection.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. The specifications and project drawings depict equipment and materials manufactured by The Gorman-Rupp Company, or approved equal.

B. After execution of the contract, the contractor may offer substitutions to the specified equipment for consideration. The equipment proposed for substitution must be superior in construction and performance to that specified in the contract, and the higher quality must be demonstrated by a list of current users of the proposed equipment in similar installations.

C. In event the contractor obtains engineer's approval for equipment substitution, the contractor shall, at his own expense, make all resulting changes to the enclosures, buildings, piping or electrical systems as required to accommodate the proposed equipment. Revised detail drawings illustrating the substituted equipment shall be submitted to the engineer prior to acceptance.

D. It will be assumed that if the cost to the contractor is less for the proposed substitution, then the contract price shall be reduced by an amount equal to the savings.

2.2 PUMP DESIGN

A. Pumps shall be horizontal, self-priming centrifugal type, designed specifically for handling raw, unscreened, domestic sanitary sewage. Pump solids handling capability and performance criteria shall be in accordance with requirements listed under PART 1 - GENERAL of this section.

B. The pump manufacturer must be ISO 9001:2008 revision certified, with scope of registration including design control and service after sales activities.

C. Materials and Construction Features

1. Pump casing shall be cast iron Class 30 with integral volute scroll. Casing shall incorporate following features:

   a. Mounting feet sized to prevent tipping or binding when pump is completely disassembled for maintenance.
   b. Fill port coverplate, 3 1/2" diameter, shall be opened after loosening a hand nut/clamp bar assembly. In consideration for safety, hand nut threads must provide slow release of pressure, and the clamp bar shall be retained by detente lugs. A Teflon gasket shall prevent adhesion of the fill port cover to the casing.
   c. Casing drain plug shall be at least 1 1/4" NPT to insure complete and rapid draining.
   d. Liquid volume and recirculation port design shall be consistent with performance criteria listed under PART 1 - GENERAL of this section.

2. Coverplate shall be cast iron Class 30. Design must incorporate following maintenance features:

   a. Retained by hand nuts for complete access to pump interior. Coverplate removal must provide ample clearance for removal of stoppages, and allow service to the impeller, seal, wearplate or check valve without removing suction or discharge piping.
   b. A replaceable wearplate secured to the coverplate by weld studs and nuts shall be AISI 1015 HRS.
   c. In consideration for safety, a pressure relief valve shall be supplied in the coverplate. Relief valve shall open at 75-200 PSI.
   d. Two O-rings of Buna-N material shall seal coverplate to pump casing.
   e. Pusher bolt capability to assist in removal of coverplate. Pusher bolt threaded holes shall be sized to accept same retaining capscrews as used in rotating assembly.
   f. Easy-grip handle shall be mounted to face of coverplate.

3. Rotating assembly, which includes impeller, shaft, mechanical shaft seal, lip seals, bearings, sealplate and bearing housing, must be removable as a single unit without disturbing the pump casing or piping. Design shall incorporate following features:

a. Sealplate and bearing housing shall be cast iron Class 30. Separate oil filled cavities, vented to atmosphere, shall be provided for shaft seal and bearings. Cavities must be cooled by the liquid pumped. Three lip seals will prevent leakage of oil.

1) The bearing cavity shall have an oil level sight gauge and fill plug check valve. The clear sight gauge shall provide easy monitoring of the bearing cavity oil level and condition of oil without removal of the fill plug check valve. The check valve shall vent the cavity but prevent introduction of moist air to the bearings.
2) The seal cavity shall have an oil level sight gauge and fill/vent plug. The clear sight gauge shall provide easy monitoring of the seal cavity oil level and condition of oil without removal of the fill/vent plug.
3) Double lip seal shall provide an atmospheric path providing positive protection of bearings, with capability for external drainage monitoring.

b. Impeller shall be ductile iron, two-vane, semi-open, non-clog, with integral pump out vanes on the back shroud. Impeller shall thread onto the pump shaft and be secured with a lockscrew and conical washer.
c. Shaft shall be AISI 4140 alloy steel unless otherwise specified by the engineer, in which case AISI 17-4 pH stainless steel shall be supplied.
d. Bearings shall be anti-friction ball type of proper size and design to withstand all radial and thrust loads expected during normal operation. Bearings shall be oil lubricated from a dedicated reservoir. Pump designs which use the same oil to lubricate the bearings and shaft seal shall not be acceptable.
e. Shaft seal shall be cartridge oil lubricated mechanical type. The stationary and rotating seal faces shall be tungsten titanium carbide alloy. Each mating surface shall be lapped to within three light bands flatness (35 millionths of an inch), as measured by an optical flat under monochromatic light. The stationary seal seat shall be double floating by virtue of a dual O-ring design; an external O-ring secures the stationary seat to the sealplate, and an internal O-ring holds the faces in alignment during periods of mechanical or hydraulic shock (loads which cause shaft deflection, vibration, and axial/radial movement). Elastomers shall be viton; cage and spring to be stainless steel. Seal shall be oil lubricated from a dedicated reservoir. The same oil shall not lubricate both shaft seal and shaft bearings. Seal shall be warranted in accordance with requirements listed under PART 1 - GENERAL of this section.
f. Pusher bolt capability to assist in removal of rotating assembly. Pusher bolt threaded holes shall be sized to accept same capscrews as used for retaining rotating assembly.

4. Adjustment of the impeller face clearance (distance between impeller and wearplate) shall be accomplished by external means.

a. Clearances shall be maintained by a four point external shimless coverplate adjustment system, utilizing a four collar and four adjusting screw design allowing for incremental adjustment of clearances by hand as required. Each of the four points shall be lockable to prevent inadvertent clearance increases or decreases due to equipment vibration or accidental operator contact. The four point system also allows for equal clearance gaps at all points between the impeller and wear plate. Requirement of realignment of belts, couplings, etc., shall not be acceptable.

Coverplate shall be capable of being removed without disturbing clearance settings. Clearance adjustment systems that utilize less than four points will not be considered.

b. There shall be provisions for additional clearance adjustment in the event that adjustment tolerances have been depleted from the coverplate side of the pump. The removal of stainless steel shims from the rotating assembly side of the pump shall allow for further adjustment as described above

c. Clearance adjustment which requires movement of the shaft only, thereby adversely affecting seal working length or impeller back clearance, shall not be acceptable.

5. Suction check valve shall be molded Neoprene with integral steel and nylon reinforcement. A blow-out center shall protect pump casing from hydraulic shock or excessive pressure. Removal or installation of the check valve must be accomplished through the coverplate opening, without disturbing the suction piping. Sole function of check valve shall be to save energy by eliminating need to reprime after each pumping cycle. Pumps requiring a suction check valve to assist reprime will not be acceptable.

6. Spool flanges shall be one-piece cast iron, class 30 fitted to suction and/or discharge ports. Each spool shall have one 1-1/4" NPT and one 1/4" NPT tapped hole with pipe plugs for mounting gauges or other equipment.

D. Serviceability

1. The pump manufacturer shall demonstrate to the engineer's satisfaction that consideration has been given to reducing maintenance costs.

2. No special tools shall be required for replacement of any components within the pump.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Immediately after off-loading, contractor shall inspect complete pump and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all pump serial numbers and parts lists with shipping documentation. Notify the manufacturer’s representative of any unacceptable conditions noted with shipper.

3.2 INSTALLATION

A. Install, level, align, and lubricate pump(s) as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.

B. Suction pipe connections are vacuum tight. Fasteners at all pipe connections must be tight. Install pipe with supports and thrust blocks to prevent strain and vibration on pump piping.

Install and secure all service lines (level control, air release valve or pump drain lines) as required in wet well.

C. Check motor and control data plates for compatibility to site voltage. Install and test the station ground prior to connecting line voltage to control panel.

D. Prior to applying electrical power to any motors or control equipment, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.After all anchor bolts, piping and control connections are installed, completely fill the grout dam in the pump station base with non-shrink grout.

3.3 FIELD SERVICE CONTROL

A. Operational Test

1. Prior to acceptance by owner, an operational test of all pumps, drives, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.

2. After construction debris and foreign material has been removed form the wet well, contractor shall supply clear water volume adequate to operate station through several pumping cycles. Observe and record operation of pumps, suction and discharge gage readings, ampere draw, pump controls, and liquid level controls. Check calibration of all instrumentation equipment, test manual control devices, and automatic control systems. Be alert to any undue noise, vibration or other operational problems.

END OF SECTION 432313.27

SECTION 432613- CHOPPER PUMP

PART 1 - GENERAL

1.1 SCOPE:

A. Under this item, the contractor shall furnish and install into operation the following;

1. (4) four vertical scum pit recirculatory chopper pump and all appurtenances as specified below. These pumps shall be installed in the Primary Clarifier scum pits as indicated on the plans.

2. (2) horizontal dry pit chopper pump and all appurtenances as specified below. These pumps shall be installed in the MBR Building as indicated on the plans.

3. The manufacturer shall provide complete simplex control panels and control instrumentation for each pump.

1.2 REFERENCES:

A. American Society for testing and material (ASTM) International

1. A 48: Standard Specification for Gray Iron Castings.

2. A743: Standard Specification Iron-Chromium Nickel, Corrosion Resistant,

B. American National Standards Institute (ANSI):

1. B16.1: Standard for Cast Iron Pipe Flanges and Flanged Fittings, 125 lb.

C. Hydraulic Institute: Current Standards.

1. HI 14.6: Hydrodynamic Pumps for Hydraulic Performance Acceptance Tests.

2. HI 11.6: Submersible Pump Tests

1.3 SUBMITTALS:

A. Submittal data shall be provided to show compliance with these specifications, plans or other specifications that will influence the proper operation of the pump(s).

B. Standard submittal data for approval must consist of:

1. Pump Performance Curves.
2. Pump Outline Drawing.
3. Electrical Motor Data.
4. Typical Installation Guides.
5. Technical Manuals and Parts List.
6. Printed Warranty.
7. Management system certificate ISO 9001.

8. Manufacturer's Equipment Storage Recommendations.
9. Manufacturer's Standard Recommended Start-Up Report Form.

C. Lack of the above requested submittal data is cause for rejection.

1.4 QUALIFICATION REQUIREMENTS

A. The manufacturer shall provide data on alternate equipment manufacturer's experience. Only Manufacturers with 20 or more years of experience who have furnished at least 5 similar projects shall be considered.

B. After installation, a pump station start-up shall be performed by the installing contractor under the supervision of the manufacture's authorized representative. 8 hours of field service shall be provided by an authorized, factory trained representative of the pump manufacturer. Services shall include, but not be limited to, inspection of the completed pump station installation to ensure that it has been performed in accordance with the manufacturer's instructions and recommendations, supervision of all field-testing and activation of the Pump Manufacturer's Warranty. The test shall demonstrate to the satisfaction of the Owner that the equipment meets all specified performance criteria, is properly installed and anchored, and operates smoothly without exceeding the full load amperage rating of the motor. The Contractor shall be responsible for coordinating the required field services with the Pump Manufacturer.

1.5 QUALITY ASSURANCE:

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of water pumps and are based on the specific system indicated.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use. ·Each completed and assembled pump/motor unit shall undergo the following factory tests at the manufacturer's plant prior to shipment. The Manufacturer shall provide on demand a copy of his quality control plan for these tests and an ISO 9001 factory certificate.

1. Minimum 3-point hydraulic performance test according HI 11.6:2012 Grade 2B
2. No-Leak seal integrity test
3. Electrical integrity test

C. Testing:

1. Each pump shall be given a Certified non-witness performance test according to Hydraulic Institute Standards and report shall be submitted to Engineer, prior to shipment of pumps.
2. Each pump shall be given a Hydrostatic test in accordance with Hydraulic Institute Standards with report submitted to Engineer, prior to shipment of pumps.

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Retain shipping protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

1.7 COORDINATION:

A. Coordinate installation of pumps with architectural and electrical requirements.

1.8 WARRANTY

A. All pumps and pump parts shall be free from defects in workmanship or material for a period of twelve (12) months from date of startup. If during said warranty period, any pump or pump parts prove to be defective in workmanship or material under normal use and service, they will be replaced or repaired by Vaughan Co. free of charge.

PART 2 - PRODUCTS

2.1 PUMP PERFORMANCE:

A. Operational Requirements

1. Primary Clarifier Scum Pit
   a. **Vaughn Model V3LR-075 x 10 Feet 6 Inches Long** Vertical wet well Recirculating Chopper Pump or Acceptable Equal

2. MBR Distribution Channel Scum Pit
   a. **Vaughn Model HE4L6CS** Horizontal Dry Well Configuration Chopper Pump or Acceptable Equal

3. Each pump shall consist of:
   a. Casing, cast ductile iron.
   b. Impeller, Cutter Bar, Cutter Nut and Upper Cutter, cast steel, heat treated to minimum Rockwell C60.
   c. Discharge Flange, 3"(**Model V3LR**) and 4”(**Model HE4L6CS**), ANSI CL 150
   d. Bearings, oil bath lubricated with minimum 100,000-hour L-10 bearing life except top bearings are grease packed (**Model V3LR only).**
   e. Mechanical Seal, cartridge type with ductile iron gland, Viton O-rings, silicon carbide faces, and integral stainless steel sleeve as manufactured by Vaughan.
   f. Elastomers, Buna-N.
   g. Coupling, elastomeric type manufactured by TB Woods.
   h. Motor Mount, fabricated steel, piloted for self-aligning mounting of the motor.
   i. Automatic Oil Level Monitor, 316 stainless steel reservoirs with 120V switch and intrinsically safe relay(**Model V3LR) or oil sight glass (Model HE4L6CS)**
   j. Recirculation Valve Assembly, cast ductile iron with a stainless steel valve disk, manually operated for recirculation or discharge. Includes reach rods through deck plate with handles for adjustment of valve and nozzle orientation from above grade (**Model V3LR only)**
   k. Recirculation Nozzle, cast ductile iron nozzle with adjustable stainless steel deflector.

(**Model V3LR only)**

l. Deck Plate, fabricated steel complete with lifting eyes and anchor bolt holes. (**Model V3LR only)**

m. Pump Finish: Sandblast and two coats 8-10 MDFT of Tnemec 27WB epoxy for a total finish of 16-20 MDFT. (Except Motor)

4. The pumps shall be specifically designed to mix and pump waste solids at heavy consistencies. Materials shall be chopped and conditioned by the pumps as an integral part of the pumping action.
5. The pumps must have demonstrated the ability to chop through and pump high concentrations of solids such as plastics, heavy rags, grease and hair balls, wood, paper products and stringy materials without plugging, both in tests and field application.
6. The hydraulic of the pump shall be capable of handling raw domestic wastewater with fibrous materials like wet wipes.
7. The impeller blades shall be self-cleaning upon each rotation as they pass across a sharp relief groove in the Insert ring and shall keep the impeller blades clear of debris.

B. Design Parameters

1. Primary Clarifier Scum Pit

a. Each pump shall be capable to lift 85 US gpm at a total dynamic head of 15 feet.

b. The hydraulic efficiency in this duty point shall be not less than 32 % and approved according to HI 11.6:2012 Grade 2B.

c. The pump shall be equipped with a **5 HP** submersible electric motor, capable to operate on a **460 volt, 3 phases, 60 hertz voltage supply.**

d. The motor speed shall be max 1170 rpm. A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output HP and efficiency. This chart shall also include data on starting and no-load characteristics.

2. MBR Distribution Channel Scum Pit

a. Each pump shall be capable to lift at a total dynamic head of 375 gpm at a total dynamic head 17.4 feet.

b. The hydraulic efficiency in this duty point shall be not less than 63.85 % and approved according to HI 11.6:2012 Grade 2B.

c. The pump shall be equipped with a **5 HP** electric motor, capable to operate on a **460 volt, 3 phases, 60 hertz voltage supply.**

d. The motor speed shall be max 1170 rpm. A performance chart shall be provided upon request showing curves for torque, current, power factor, input/output HP and efficiency. This chart shall also include data on starting and no-load characteristics.

2.2 PUMP PARTS AND PRODUCTS

A. Casing:

1. Shall be of volute design, spiraling outward to the Class 125 flanged centerline discharge. Casing shall be ductile cast iron with all water passages to be smooth, and free of blowholes and imperfections for good flow characteristics. Casing shall include a replaceable Rockwell C 60 alloy steel cutter to cut against the rotating impeller pump-out vanes for removing fiber and debris.

B. Impeller:

1. Shall be semi-open type with pump out vanes to reduce seal area pressure. Chopping/maceration of materials shall be accomplished by the action of the cupped and sharpened leading edges of the impeller blades moving across the cutter bar at the intake openings, with a set clearance between the impeller and cutter bar of 0.015-0.025" cold. Impeller shall be cast alloy steel heat treated to minimum Rockwell C 60 and dynamically balanced. The impeller shall be keyed to the shaft and shall have no axial adjustments and no set screws.

C. Cutter Bar Plate:

1. Shall be recessed into the pump casing and shall contain at least 2 shear bars extending diametrically across the intake opening to within 0.010-0.030" of the rotating cutter nut tooth, for the purpose of preventing intake opening blockage and wrapping of debris at the shaft area. Chopper pumps utilizing individually mounted shear bars shall not be acceptable. Cutter bar shall be alloy steel heat-treated to minimum Rockwell C 60.

D. Cutter Nut:

1. The impeller shall be secured to the shaft using a cutter nut, designed to cut stringy materials and prevent binding using a raised, rotating cutter tooth. The cutter nut shall be cast alloy steel heat treated to minimum Rockwell C 60.

E. Upper Cutter:

1. Shall be threaded into the casing or back pull-out adapter plate behind the impeller, designed to cut against the pump-out vanes and the impeller hub, reducing and removing stringy materials from the mechanical seal area. Upper cutter shall be cast alloy steel heat treated to minimum Rockwell C 60. The upper cutter teeth are positioned as closely as possible to the center of shaft rotation to minimize cutting torque and nuisance motor tripping. The ratio of upper cutter cutting diameter to shaft diameter in the upper cutter area of the pump shall be 3.0 or less.

F. Recirculation Nozzle Assembly (Primary Scum Pumps Only):

1. The pump shall be fitted with a recirculation nozzle assembly to permit recirculation / conditioning of the pit contents prior discharge. The recirculation nozzle shall be adjustable minimum 180° horizontally and 45° vertically. A valve assembly shall be connected to the pump discharge flange. Valve assembly shall be connected to the pump discharge to adjust pump flow either to the nozzle or the pump discharge flange. Valve shall be ductile cast iron, with 316 SS valve disk. The operating levers shall be located above at a mounting plate for

easy access.

G. Pump Shafting

1. Shall be heat treated alloy steel. Upper shaft extension shall be turned, ground and polished. The shaft column shall be minimum 3-1/2" schedule 40 steel pipe welded to steel flanges and machined with piloted bearing fits for concentricity of all components. All support column tubes shall be leak tested. Distance between shaft bearings shall not exceed critical speed dimensions.

H. Pump Shaft Bearings:

1. Shall be oil bath lubricated by ISO 46 hydraulic oil, with the exception of the top bearing, which shall be grease packed. The bearing shall have a minimum L-10 life rated 100,000 hours. Shaft thrust shall be taken up by either a double row angular contact ball bearing or two back-to-back mounted single row angular contact ball bearings, which bear against a machined shoulder on one side and the seal sleeve on the other side. Overhang from the centerline of the lower thrust bearing to the seal faces shall be a maximum of 1.7", with a mechanical seal to isolate the bearings from the pumped media.

I. Pump Mechanical Seal:

1. The mechanical seal shall be located immediately behind the impeller hub to maximize the flushing available from the impeller pump-out vanes. The seal shall be a cartridge-type mechanical seal with Viton O-rings and silicon carbide (or tungsten carbide) faces. This cartridge seal shall be pre-assembled and pre-tested so that no seal settings or adjustments are required from the installer. Any springs used to push the seal faces together must be shielded from the fluid to be pumped. The cartridge shall also include a 17-4PH, heat-treated seal sleeve and a ductile cast iron seal gland.

J. Automatic Oil Level Monitor:

1. Shall be located above the mounting plate and be fitted with an internal oil level switch to monitor oil level and shut off the motor in event of low oil level. A relay shall be included for mounting in the motor control panel.

K. Pump Discharge Pipe:

1. The pump assembly shall be mounted vertically on a common steel plate with a Class150 discharge flange. An NPT pressure tap shall be located above the deck plate. (**Model V3LR only).**

L. Shaft Coupling:

1. Shall be T.B Woods Sureflex elastomeric type with a minimum 1.5 service factor based on the drive rated horsepower and shall be protected with a guard meeting OSHA requirements.

M. Motor Stool:

1. Shall be fabricated carbon steel weldment machined with piloted fits to positively align the C-flanged motor and pump shaft, with no adjustments.

N. Pump Deck Plate:

1. Shall be fabricated carbon steel, 1/2” minimum thickness, and shall include lifting lugs. (**Model V3LR only).**

O. Stainless Steel Nameplate:

1. Shall be attached to the pump giving the manufacturer`s model and serial number, rated capacity, head, speed, and all pertinent data.

P. Motor Requirements:

1. Electric Drive motor shall be C-Flange mounted premium efficient electric motor
2. 5 HP, 1170 RPM, 230/460 Volts, 3 phase and 60 Hertz, 1.15 service factor TEFC enclosure. The motor shall be sized for non-overloading conditions.
3. Drip Cover for 215TC Frame

Q. Premium Surface Preparation:

1. Sandblast and two coats 8-10 MDFT of Tnemec 27WB epoxy for a total finish of 16-20 MDFT. (Except Motor)

2.3 PUMP CONTROL PANEL AND CONTROL INSTRUMENTATION (PRIMARY CLARIFIER)

A. The contractor shall furnish and install complete Simplex Control Panels and control instrumentation for each scum pump as shown on the plans. Each panel shall include;

1. NEMA 4x stainless steel enclosure with back panel, dead front, and padlocking handle
2. Main circuit breakers with disconnect kit
3. 480V surge protection with bracket
4. 120V surge protection with bracket
5. Fused control transformer with required accessories
6. IEC contactor with overload
7. Elapsed time meter
8. H-O-A Switch
9. Reset push button
10. 22mm Indicator Lights
11. All related and required ancillary equipment to build a complete and function panel

B. The manufacturer shall include pump control instrumentation, and the contractor shall install in the location as indicated on the plans.

1. Control instrumentation shall be Ultrasonic Level Control Sensor by Endress + Hauser Prosonic FDU91 with Prosonic FMU90 Transmitter supplied with sensor support and wall bracket for sensor support.

2.4 PUMP CONTROL PANEL AND CONTROL INSTRUMENTATION (MBR SCUM PUMP)

A. The contractor shall furnish and install complete Duplex Control Panels and control instrumentation for each scum pump as shown on the plans. Each panel shall include;

1. NEMA 4x stainless steel enclosure with back panel, dead front, and padlocking handle

2. Main circuit breakers with disconnect kit
3. 480V surge protection with bracket
4. 120V surge protection with bracket
5. Fused control transformer with required accessories
6. IEC contactor with overload
7. Elapsed time meter
8. H-O-A Switch
9. Reset push button
10. 22mm Indicator Lights
11. All related and required ancillary equipment to build a complete and function panel

B. The manufacturer shall include pump control instrumentation, and the contractor shall install in the location as indicated on the plans.

1. Control instrumentation shall be Ultrasonic Level Control Sensor by Endress + Hauser Prosonic FDU91 with Prosonic FMU90 Transmitter supplied with sensor support and wall bracket for sensor support (O.A.E.)
2. Typical float switches shall be SJE Rhombus supplied with sufficient cable length and mounting bracket for installation (O.A.E)

PART 3-EXECUTION

3.1 GENERAL

A. Perform installation in accordance with Contract Documents and manufacturers specifications.

3.2 EXAMINATION:

A. A factory trained technician shall examine the work area prior to beginning work and check the following:

1. The environment is safe to begin working in
2. All surfaces are ready to receive work
3. All tools are in the proper location and are in good condition
4. Grounding of the system

3.3 INSTALLATION:

A. All electrical power and control wiring shall be installed by the Electrical Contractor.

B. Install pumps according to the manufacturer's written instructions.

C. Install pumps in location shown on plans, or location that will allow operators to remove pumps without conflict with other piping.

3.4 FIELD QUALITY CONTROL

A. The follow field tests shall be performed by a factory trained technician

1. Point to point wiring verification
2. Utility power verification
3. Site acceptance testing
4. System demonstration

B. Point to Point I/0 Verification

1. After installation of the pumps and the control panel, a factory trained technician shall prepare the 1/0 checklist. The checklist shall include the following:

   a. All inputs and outputs connected to thecontrol panel
   b. All alarms that can be generated by the controlpanel

2. The technician shall follow a test procedure to test all I/0 and alarms.

   a. All digital inputs shall be tested from point of origin unless it is unsafe.
   b. All digital outputs shall be tested by running a simulation test from the controller or by simulating the fault condition.
   c. All analog inputs shall be tested from the point of origin where possible and by use of a signal generator otherwise.
   d. All analog outputs shall be tested by running asimulation program or by forcing the output to a value.

3. Configuration Verification

   a. The factory trained technician shall document the settings using a factory provided configuration checklist. Each parameter shall be verified prior to the beginning of testing and then again after testing is completed.
   b. The configuration of the pump station manager as well as the JPS gateways shall be documented.
   c. The pump station manager configuration shall be saved to a factory provided SD card after testing is completed.

3.5 START UP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions.

C. Start pumps without exceeding safe motor power:

1. Start motors.
2. Check general mechanical operation of pumps and motors.
3. Test and adjust controls and safeties on both local and at the MCP for proper operation.
4. Remove and replace damaged and malfunctioning components.
5. Pump Controls: Set pump controls for automatic start, stop, and alarm operation as required for system application.
6. Set field-adjustable switches and circuit-breaker trip ranges as indicated, or if not indicated, for normal operation.

3.6 CERTIFICATION OF TESTING

A. All tests shall be performed in the presence of a duly authorized representative of the Owner. If the presence is waived, certified results shall be provided by the Contractor.

B. Written notice of all tests shall be given two weeks in advance.

C. All test equipment shall be provided by the Contractor.

3.7 DEMONSTRATION AND TRAINING:

A. Training provided by the Manufacturer's authorized representative shall be a minimum of four (4) hours and cover the complete Pumping System and related controls.

B. Instruction material shall be provided for four (4) trainees.

C. Two (2) copies of the Operation and Maintenance Manuals shall be provided to the owner

END OF SECTION 432613

SECTION 432618.10 – SUBMERSIBLE SEWAGE PUMPS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SECTION INCLUDES

A. Submersible sewage pumps for

1. Belt Dewatering press filtrate.
2. MBR drain pump station.

B. Instrumentation & Control panels to run submersible sewage pumps

1.3 DESCRIPTION OF WORK

A. Under this Section the Contractor shall furnish and install submersible pumps, slide rail pump removal system, ductile iron discharge piping with required supports and fittings, discharge check and plug valves, liquid level controls, duplex pump control panel, internal wiring and other required appurtenances.

1.4 SERVICE CONDITIONS

A. All components of the system shall be designed for continuous duty.

1.5 SUBMITTALS

A. Submittal data shall be provided to show compliance with these specifications, plans or other specifications that will influence the proper operation of the pump(s).

B. Standard submittal data for approval must consist of:

1. Pump Performance Curves.
2. Pump Outline Drawing..
3. Electrical Motor Data.
4. Control Drawing (including electrical ladder diagram) and Data.
5. Typical Installation Guides.
6. Technical Manuals.
7. Parts List.
8. Printed Warranty (including non-clog requirement Section 1.10D).
9. Manufacturer's Equipment Storage Recommendations.

10. Manufacturer's Standard Recommended Start-Up Report Form.
11. Factory Performance Testing Results for Reference Only to Published Pump Curve at 60Hz speed per Hydraulic Institute Grade 2B before shipment.
12. Wiring Diagrams: Submit manufacturer's electrical requirements for packaged pump stations including ladder-type wiring diagrams for interlock and control wiring, clearly indicating required field electrical connections.

1.6 QUALITY ASSURANCE

A. The pump(s) shall be heavy duty, electric submersible, centrifugal non-clog units designed for handling raw, unscreened sewage and wastewater and shall be fully guaranteed for this use. The pumps provided shall be capable of operating in an ambient liquid temperature of 104 degrees F. Since the high temperature of 104 degrees F is specified by the National Electrical Manufacturers Association (NEMA) and Factory Mutual (FM), motors with a maximum ambient temperature rating below 104 degrees F shall not be acceptable.

B. The pump and motor unit shall be suitable for continuous operation at full nameplate load while the motor is completely submerged, partially submerged or totally non-submerged. The use of shower systems, secondary pumps or cooling fans to cool the motor shall not be acceptable.

C. The pump, mechanical seals and motor units provided under this specification shall be from the same manufacturer in order to achieve standardization of operation, maintenance, spare parts, manufacturer's service and warranty

D. All electrical materials, devices, and equipment shall be UL listed wherever applicable.

E. All equipment and installations shall meet the National Electric Code.

F. The manufacturer shall furnish the services of an experienced service technician or engineer to check the installation and shall file in triplicate, with the Owner, a certificate indicating that the pre-packaged submersible pump station has been installed in accordance with the manufacturer's recommendations and that a performance test has been run satisfactorily.

G. Factory test: During construction and before shipment, all equipment shall be tested for excessive vibration and proper operation. All components shall be thoroughly inspected to ensure satisfactory operation after installation.

1.7 START-UP SERVICE

A. The equipment manufacturer shall furnish the services of a qualified factory trained field service engineer for 8-hour working day(s) at the site to inspect the installation and instruct the owner's personnel on the operation and maintenance of the pumping units. After the pumps have been completely installed and wired, the contractor shall have the manufacturer do the following:

1. Megger stator and power cables.
2. Check seal lubrication.
3. Check for proper rotation.
4. Check power supply voltage.

5. Measure motor operating load and no-load current.
6. Check level control operation and sequence.

B. During this initial inspection, the manufacturer's service representative shall review recommended operation and maintenance procedures with the owner's personnel.

1.8 GUARANTEE

A. Provide a warranty certificate typed on manufacturer’s letterhead.

B. In addition, the manufacturer shall guarantee all components of the equipment specified to be furnished under this Section to be free from defects in design, materials and workmanship for a period of one (1) year commencing on the date of the Manufacturer’s Startup Report. That being the day that the pump was placed into permanent, automatic, and consistent, fault free operation.

PART 2 – PRODUCTS

2.1 SUBMERSIBLE PUMPS

A. Performance

1. Belt dewatering filtrate pumps:

   a. The pump shall be supplied with a mating cast iron 4inch discharge connection and be capable of delivering 205 GPM at 39.3 ft TDH at full speed with an efficiency of 56.3%. Pumps shall be Flygt model NP 3102 MT 3, O.A.E.

2. MBR Drain pumps

   a. The pump shall be supplied with a mating cast iron 3-inch discharge connection and be capable of delivering 59 GPM at 23.5 ft TDH at full speed with an efficiency of 47%. Pumps shall be Flygt Model NP 3085 SH3 O.A.E.

3. The pump(s) shall be automatically and firmly connected to discharge connection, guided by no less than two guide bars extending from the top of the station to the discharge connection. There shall be no need for personnel to enter the wet-well. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. Sealing of the discharge interface with a diaphragm, O-ring or profile gasket will not be acceptable. No portion of the pump shall bear directly on the sump floor. Each pump shall be fitted with an adequate length of lifting chain or stainless-steel cable. The working load of the lifting system shall be 50% greater than the pump unit weight.

4. Sealing design shall incorporate metal-to-metal contact between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or optional Viton rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.

5. Rectangular cross-sectioned gaskets requiring specific torque limits to achieve compression shall not be considered as adequate or equal. No secondary sealing compounds, elliptical O-rings, grease or other devices shall be used.

6. Motor cooling shall be sufficient for continuous operation under full nameplate load in a dry environment. The pump(s) shall be capable of handling pumped media up to 104 degrees F.

B. Pump Impellers

1. The impeller shall be of in Hard-IronTM (ASTM A-532 (Alloy III A) 25% chrome cast iron), dynamically balanced, semi-open, multi-vane, back-swept, non- clog design. The impeller vane leading edges shall be mechanically self- cleaned upon each rotation as they pass across a spiral groove located on the volute bottom. The internal volute bottom shall provide effective sealing between the pump volute and the multi-vane, semi-open impeller. The sharp spiral groove(s) shall provide the shearing edge(s) across which each impeller vane leading edge shall cross during its rotation in order to remain unobstructed. The clearance between the internal volute bottom and the impeller leading edges shall be adjustable.

C. Pump Volute / Suction Cover:

1. The pump volute shall be a single piece grey cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified.

2. The volute shall have a replaceable suction cover insert ring in which are cast spiral-shaped, sharp-edged groove(s). The spiral groove(s) shall provide trash release pathways and sharp edge(s) across which each impeller vane leading edge shall cross during rotation so to remain unobstructed.

3. The insert ring shall be cast of Hard-IronTM (ASTM A-532 (Alloy III A) 25% chrome cast iron) when used with Hard-IronTM impellers and provide effective sealing between the multi-vane semi-open impeller and the volute housing.

D. Pump Shafts:

1. The pump and motor shaft shall be a single piece unit. The pump shaft is an extension of the motor shaft. Shafts using mechanical couplings shall not be acceptable. The shaft shall be stainless steel - ASTM A479 S43100-T. Shaft sleeves will not be acceptable.

E. Pump Bearings:

1. The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated. The upper bearing shall be a single deep groove ball bearing.

2. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Single row lower bearings are not acceptable. The minimum L10 bearing life shall be 50,000 hours at any usable portion of the pump curve.

F. Pump Mechanical Seals:

1. Each pump shall be provided with a positively driven dual, tandem mechanical shaft seal system consisting of two seal sets, each having an independent spring. The lower primary seal, located between the pump and seal chamber, shall contain one stationary and one positively driven rotating corrosion and abrasion resistant tungsten-carbide ring. The upper secondary seal, located between the seal chamber and the seal inspection chamber shall be a leakage-free seal. The upper seal shall contain one stationary and one positively driven rotating corrosion and abrasion resistant tungsten-carbide seal ring. The rotating seal ring shall have small back-swept grooves laser inscribed upon its face to act as a pump as it rotates, returning any fluid that should enter the dry motor chamber back into the lubricant chamber. All seal rings shall be individual solid sintered rings. Each seal interface shall be held in place by its own spring system. The seals shall not depend upon direction of rotation for sealing. Mounting of the lower seal on the impeller hub is not acceptable. Shaft seals without positively driven rotating members or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces are not acceptable. The seal springs shall be isolated from the pumped media to prevent materials from packing around them, limiting their performance.

2. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and shall provide capacity for lubricant expansion. The seal lubricant chamber shall have one drain and one inspection plug that are accessible from the exterior of the motor unit. The seal system shall not rely upon the pumped media for lubrication.

3. The area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.

4. A separate seal leakage chamber shall be provided so that any leakage that may occur past the upper, secondary mechanical seal will be captured prior to entry into the motor stator housing. Such seal leakage shall not contaminate the motor lower bearing. The leakage chamber shall be equipped with a float type switch that will signal if the chamber should reach 50% capacity.

G. Pump Power and Control Cables:

1. The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.

2. The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of dual cylindrical elastomer grommets,

flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter. The grommets shall be compressed by the cable entry unit, thus providing a strain relief function. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be sealed from each other, which shall isolate the stator housing from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered equal.

3. The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The power cable shall be of a shielded design in which an overall tinned copper shield is included and each individual phase conductor is shielded with an aluminum coated foil wrap. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.

H. Pump Motors:

1. The belt press dewatering pump motor shall be 5HP, 460v, 3PH

2. The MBR drain pump motor shall be 2.2HP, 460v, 3PH.

3. Motors shall be NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31.The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of pins, bolts, screws or other fastening devices used to locate or hold the stator and that penetrate the stator housing are not acceptable. The motor shall be designed for continuous duty while handling pumped media of up to 104°F. The motor shall be capable of no less than 30 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of aluminum. Three thermal switches shall be embedded in the stator end coils, one per phase winding, to monitor the stator temperature. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the motor control panel.

4. The junction chamber shall be sealed off from the stator housing and shall contain a terminal board for connection of power and pilot sensor cables using threaded compression type terminals. The use of wire nuts or crimp-type connectors is not acceptable. The motor and the pump shall be produced by the same manufacturer.

5. The motor service factor (combined effect of voltage, frequency and specific gravity) shall be 1.15. The motor shall have a voltage tolerance of +/- 10%. The motor shall be designed for continuous operation in up to a 40°C ambient and shall have a NEMA Class B maximum operating temperature rise of 80°C. A motor performance chart shall be provided upon request exhibiting curves for motor torque, current, power factor, input/output kW and efficiency. The chart shall also include data on motor starting and no-load characteristics.

6. Motor horsepower shall be sufficient so that the pump is non-overloading throughout its entire performance curve, from shut-off to run-out. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.

7. A leakage sensor shall be provided to detect water in the stator chamber. The Float Leakage Sensor (FLS) is a small float switch used to detect the presence of water in the stator chamber. When activated, the FLS will stop the motor and send an alarm both local and/or remote. USE OF VOLTAGE SENSITIVE SOLID STATE SENSORS AND TRIP TEMPERATURE ABOVE 125°C (260°F) SHALL NOT BE ALLOWED.

I. Pump Cooling System

1. Motors are sufficiently cooled by the surrounding environment or pumped media. A water cooling jacket is not required.

2. Each unit shall be capable of dry-running for up to 2 hours without damaging the motor.

J. Explosion-Proof Pumps

1. The pump system including the pump, motor and power cable shall be approved for use in areas classified as hazardous locations in accordance with the NEC Class I, Div. 1, Group C and D service as determined and approved by a U.S. nationally recognized testing laboratory (U.L., FM, CSA) at the time of the bidding of the project. As required by Factory Mutual (FM) the motor shall be capable of operating in pumped media up to 104 degrees F. Motor thermal switches shall monitor and protect the motor from excessive temperature. An internal Float Switch shall be available, as an option, in the motor chamber.

2.2 ELECTRIC CONTROLS:

A. GENERAL

1. Each set of duplex pumps shall be provided with a duplex pump control system.

2.3 WIRING:

A. The conductors shall be in complete conformity with the National Electric Code, state, local and NEMA electrical standards.

B. To ensure the safety of all personnel working with this equipment, as well as providing a simple means of tracing wires when troubleshooting, all wiring shall be color coded in strict accordance with the wiring diagrams furnished by the equipment supplier.

C. All job connections required for conveniently replacing control components shall be made at approved type terminal blocks with engraved Bakelite marker strips or similar approved means.

2.4 UL - INTRINSICALLY SAFE APPROVAL:

A. The control panel shall be constructed in compliance with Underwriters Laboratories Industrial Control Panels listing and follow-up service; utilizing UL listed and recognized components where applicable. The control panel shall bear the Underwriters Laboratories 508/698A serialized label relating to hazardous locations with intrinsically safe circuit extensions.

2.5 ENCLOSURE:

A. The described equipment shall be housed in a NEMA 4X stainless steel enclosure arranged for mounting on a support stand as shown on the drawings. The enclosure shall be constructed of not less than 14 gauge #304 stainless steel.

B. This weather proof, tamper proof, rain-tight enclosure shall be designed specifically for mounting in an unprotected outdoor location. The enclosure shall be gasketed. It shall have a hinged front weather door with 3 point padlocking capability and an internally mounted hinged aluminum inner panel so that all the components normally actuated by operating personnel are accessible without opening the dead front and yet are not exposed to the elements or to unauthorized personnel.

1. All seams shall be continuously welded and ground smooth.
2. Door and body stiffeners shall be provided for extra rigidity.
3. Captivated door screws thread into sealed wells.
4. Heavy gauge continuous hinge.
5. Removable and reversible print pocket.
6. Oil resistant gasket and adhesive.
7. Collar studs shall be provided for mounting panel.

C. All field installed conduits, fittings or connections shall enter the enclosure through the bottom only for any outdoor enclosure.

D. All major components and sub-assemblies shall be identified as to function with laminated, engraved Bakelite nameplates or similar approved means.

2.6 INSULATION:

A. The enclosure shall be completely insulated on all interior surfaces with ½" thick AP/Armaflex expanded closed-cell flexible elastomeric thermal insulation, black in color. The insulation shall be neatly installed using Armaflex 520 adhesive.

2.7 POWER SUPPLY AND METERING:

A. The incoming service shall be 460 volts, 3 phase, 3 wire, 60 cycle.

2.8 MAIN CIRCUIT BREAKER

A. A molded case circuit breaker shall be provided as the main power disconnecting device for the control panel. The circuit breaker must have a minimum ampere interrupting capacity of (25,000-240 volt - 18,000-480 volt) symmetrical RMS amps. The circuit breaker shall be adequately sized for the pumps provided.

2.9 LIGHTNING ARRESTOR

A. A lightning arrestor shall be supplied in the control and connected to each line of the main power input terminals. The arrestor shall protect the control against damage due to lightning strikes on the incoming power line.

2.10 PHASE MONITOR

A. A solid state, phase sequence/failure and under voltage release relay shall be provided to ensure additional running protection for the pump motors. The relay shall be complete with an LED to indicate proper phase sequence, all phases in operation and voltage within limits. The relay shall also include an adjustable voltage monitor, be UL and CSA certified and be complete with automatic reset feature.

2.11 PUMP CIRCUIT BREAKER

A. A thermal magnetic circuit breaker shall be supplied as branch circuit protection for each pump motor. The circuit breaker must have a minimum ampere interrupting capacity of (25,000-240 volt – 18,000-480 volt) symmetrical RMS amps. The circuit breaker shall be operable through the operator's door of the enclosure.

B. The circuit breaker shall be properly sized to protect the motor conductors, motor starter and the motor against over current due to short circuit or grounds.

2.12 LIGHTING TRANSFORMER:

A. The panel shall include a dry type lighting transformer with a sufficient KVA rating to operate all 120-volt loads. A properly sized primary circuit breaker shall be provided. This transformer may not be required if 120 volts can be obtained from the incoming service.

2.13 RECEPTACLE:

A. An operator's door mounted ground fault interrupter (GFI) type convenience receptacle rated at 15 amperes shall be supplied for the operating of trouble lights, drill, etc. It shall be protected by a separate 15-ampere trip rated circuit breaker.

2.14 CONDENSATION PROTECTIVE HEATER:

A. A 200-watt, 120 VAC thermostatically controlled, fan driven heater shall be supplied in the control panel to maintain a stable temperature and protect the electrical and electronic equipment from the harmful effects of condensation, corrosion and low temperatures.

2.15 SYSTEM OPERATION:

A. The control panel shall function as a duplex system. Operation of the pumps will be staged in a lead/lag sequence.

B. The primary control will consist of a programmable controller, operator interface and submersible level float switch as specified hereafter.

2.16 PUMP CONTROLLER

A. The control system shall utilize standard "off the shelf" equipment. Job specific, "one-of-a-kind" customized software and hardware components will not be accepted. A standard system is defined, as one, which has published literature, is available at time of bid, with fully tested hardware and software, such that no development must be done beyond system configuration.

B. The equipment shall be protected from transient voltages and surges induced into the signal lines. The contractor shall provide a permanent earth ground connection to the panel ground lug in order to insure proper operation of transient protectors.

C. A microprocessor-based automatic pump and alarm control system shall be provided for each pumping station incorporating an industrial-grade, 16-bit CMOS microcomputer and associated elements suitable for achieving performance as hereinafter described. The controller will incorporate the following:

1. Internal diagnostics.
2. Real time clock calendar.
3. Floating-point math.
4. Battery back up.
5. Non-proprietary RTU communication.
6. (4) PID loops.

D. The system shall incorporate UL 508 Industrial Control Panel approved elements as required of all components of these project panels and be furnished with all necessary hardware and software to accomplish level-responsive pump and alarm operation with software specifically suited to this project.

E. All of the discrete I/O circuitry of the computer-based system shall be built to the IEEE 472 (1974) Surge Withstand Capability Standards. The automatic pump and alarm control system computer shall be the standard product of the control system manufacturer and specifically suited for this type of industrial control panel service. All job connections shall be a UL recognized clamp type barriered screw terminals accepting up to two AWG 14 conductors per terminal.

F. An alternator shall operate the pumps in a First-on/First-off (FOFO) sequence and can be configured to sequence the pumps every start, every 24 hours, on the lowest run time or manually.

G. The alternator shall be capable of accepting pump failure and/or advance inputs and shall automatically transfer to the next pump sequence when failure condition input is sensed.

H. The alternator shall provide automatic transposing of the operating sequence of the control relays for the pumps on successive starts. The FOFO alternator sequencing shall operate such that the next load turned on is always the one that has had the longest opportunity to rest since its last operation.

I. It is the specific intention of this functional requirement that a standard programmable logic controller will be employed with features as herein described and be a fully integrated assembly. That is, the furnishing of similar functions using a proprietary controller with custom software, a multiplicity of set points, modules or extensive relay-timer logic to accomplish control sequences, etc., is specifically precluded by this specification and will not be acceptable.

J. The automatic pump and alarm control shall employ a backlit LCD operator interface having a 320 x 240 pixel 7" 65K color display with touch screen. The operator interface shall be IEC standard IP65F rated. The display also must support bar graphs or analog meters for wetwell levels. Operator interface must support screen scrolling and three levels of password protection. The interface must support a printer port.

K. A Configuration and Operations Manual will be included for the pump controller. The Manual shall include the following information as a minimum:

1. How to view and change between the various displays.
2. How to configure the controller.
3. How to display alarms.
4. How to display statuses.
5. Analog control set point adjustment.
6. Analog alarm set point adjustment.
7. How to view and reset pump run times.
8. How to view and reset pump start counters.
9. Security Password usage.
10. An example of programming values.
11. Adjustment of the real-time calendar/clock.
12. A listing of values programmed at the factory.
13. A worksheet for entering the values programmed in the field.

L. Float operation (High Level, Pump Start, Pumps Off)

When the high float is activated, the controller will call the lead pump and signal the alarm. If the float does not deactivate in a predetermined adjustable time the lag pump will also start. When the pumps off float is deactivated, the pump(s) will be turned off. Each subsequent activation of the pump start float will turn the lead pump on. Each subsequent activation of the high level or low level float will turn the high or low alarm output contacts on.

2.17 ALARM MESSAGES:

A. In the event of an alarm condition the operator interface will display an alarm message. Press the ‘Alarm Ack’ button to acknowledge the alarm and ‘Alarm Reset’ button to clear the alarm. The following list of alarms shall be provided:

1. Low Level.
2. High Level.
3. Pump 1 Fail.
4. Pump 2 Fail.
5. Transducer Fail.
6. Seal 1 Fail.
7. Seal 2 Fail.
8. Motor 1 Overtemp.
9. Motor 2 Overtemp.
10. Pump 1 Fail (Configurable from external device).
11. Pump 2 Fail (Configurable from external device).

2.18 PUMP SEAL FAIL:

A. A seal failure relay specifically designed to interface with a contact closure from each of the specified pumps will be included. A Seal Fail alarm message will be displayed on the controller. In addition the controller can be configured to shut down the pump or designate it to the lag position until the condition is corrected.

2.19 OVER TEMPERATURE PUMP PROTECTION:

A. Over temperature protection relays shall be provided in the control panels to operate in conjunction with the over temperature switch in each pump motor. The controller shall provide an Overtemp Fail alarm message and pump lockout of operation upon occurrence of high temperature. The circuitry shall also include a reset push button on the controller for manual reset capability.

2.20 SELECTOR SWITCHES:

A. A 22 mm oil tight three-position, “Hand-Off-Automatic” selector switch shall be flush-mounted on the operator’s door of the control panel for the operation of each VFD. This selector switch shall operate the VFD when it is in either the "Hand" position or the "Automatic" position, and the automatic control system is calling for the operation of the equipment in the manner as herein described.

2.21 STATUS INDICATORS:

A. A 22 mm oil tight green "Pump Running" pilot light shall be flush-mounted on the operator’s door of the control panel. This pilot light shall be operated from a respective run contact. The pilot light shall have a replaceable bulb.

2.22 WEATHERPROOF ALARM LIGHT:

A. A weatherproof 40-watt alarm light assembly including a high impact resistant lexan red lens shall be included. The alarm light bulb shall be replaceable from inside the control panel without having to remove the weatherproof red lens from the panel.

B. A solid-state flasher shall be included to strobe the alarm light for any of the specified alarm conditions.

2.23 WEATHERPROOF ALARM HORN:

A. A weatherproof audible U.L. Listed alarm horn shall be provided. The horn will be side mounted to the control panel, and shall operate on 115 VAC with a typical 95 DB output. An alarm silence push button shall be included, mounted on the operator's door.

2.24 SHOP DRAWINGS:

A. A complete set of drawings shall be supplied to insure successful installation and operation of the control system. The shop drawings shall consist of all of the following:

1. Sufficient detail to evaluate compliance with these specifications.
2. A detailed component list including manufacturer and catalog number.
3. A custom-wiring diagram for this specific application to facilitate and insure accurate field connections to the control panel by electrical installation personnel.
4. A description of operation for the control system.
5. An enclosure dimension print.

PART 3 – EXECUTION

3.1 EXAMINATION:

A. Install pumps and pump control panel according to the manufacturer's written instructions.

B. Install pump control panel in location shown on plans and location that will allow operators to access panel without conflicts.

3.2 STARTUP SERVICE:

A. Engage a factory-authorized service representative to perform startup service for a minimum of one 4-hour day for each set of duplex pumps.

B. Complete installation and startup checks according to manufacturer's written instructions.

C. Start pumps without exceeding safe motor power:

1. Start motors.
2. Check general mechanical operation of pumps and motors.
3. Test and adjust controls and safeties on both local and at the MCP for proper operation.
4. Remove and replace damaged and malfunctioning components.

5. Pump Controls: Set pump controls for automatic start, stop, and alarm operation as required for system application.
6. Set field-adjustable switches and circuit-breaker trip ranges as indicated, or if not indicated, for normal operation.

3.3 DEMONSTRATION:

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps for a minimum period of one 4-hour day.

B. Operation and Maintenance Manuals: Two (2) hard copies of the Operation and Maintenance manual along with an electronic version supplied on a flash drive shall be provided to the Owner’s representative upon completion of start up.

END OF SECTION 432618.10

SECTION 432618.20 – SUBMERSIBLE SEWAGE PUMPS (RDT FILTRATE)

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes:
   1. Submersible Non-Clog Sewage Pumps

1.3 SUBMITTALS:

A. Product Data: For each type and size of pump specified. Rated capacities of selected models, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring. Dimensions for base mounting, inlet and outlet piping, length, width, height, and all other critical dimensions.

C. Operation and Maintenance Data: For each type of pump.

D. Coating information: Provide primer and coating information for any interior or exterior applied coatings.

1.4 QUALITY ASSURANCE:

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of water pumps and are based on the specific system indicated.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

   1. Minimum 3-point hydraulic performance test according HI 11.6:2012 Grade 2B
   2. No-Leak seal integrity test
   3. Electrical integrity test

C. Testing:

   1. Each pump shall be given a Certified non-witness performance test according to Hydraulic Institute Standards and report shall be submitted to Engineer, prior to shipment of pumps.

   2. Each pump shall be given a Hydrostatic test in accordance with Hydraulic Institute Standards with report submitted to Engineer, prior to shipment of pumps.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Retain shipping protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

1.6 COORDINATION:

A. Coordinate installation of pumps with existing structure and electrical requirements.

PART 2 – PRODUCTS

2.1 SCOPE:

A. Furnish, (2) two Sulzer-ABS Model XFP 100E-CB2 Submersible Premium Efficiency Non-Clog wastewater pumps, or acceptable equal. The pumps shall be supplied with a mating cast iron four inch discharge connection. The motor shall be an integral part of the pump unit. The motor shall be 7.5 HP connected for operation on a 460 volt, 3 phase, 60 hertz electrical supply service. The pumps are intended for wet pit installation shall be supplied with a cast iron guide rail system with an integrated four inch discharge elbow. Each pump unit shall be fitted with a SS grab link assembly, 25 feet long for lifting the pump. The working load rating of the lifting system shall be a minimum of 50% greater than the pump weight. Each pump motor shall be equipped with 49 feet of power and control cable sized in accordance with NEC and CSA standards.

2.2 PUMP DESIGN:

A. The heavy duty submersible wastewater pump(s) shall be capable of handling raw unscreened sewage, storm water, and other similar solids-laden fluids without clogging. The pump shall be driven by a **Premium Efficiency motor**, providing the highest levels of operational reliability and energy efficiency.

B. Design Parameters
   1. Primary design point: 334 GPM @ 43 Ft. TDH with a minimum efficiency of 61% and maximum NPSHR of 6.5 ft.
   2. Minimum shutoff head of 56 Ft.
   3. Minimum motor efficiency of 90% at full load, 89% at 75% load, and 87% at 50% load.
   4. Pump Model: ABS Model XFP 100E-CB1 or acceptable equal.
   5. Number of pumps: 2
   6. Power: 460v/3ph.

2.3 GUIDE RAIL BASE ASSEMBLY:

A. There shall be no need for personnel to enter the wet well to remove or reinstall the pump(s). In a wet pit installation, the discharge base & elbow assembly shall be permanently installed in the

wet well and connected to the discharge piping. In order to prevent binding or separation of the pump from the guide rail system, the pumps shall connect to the guide rail base automatically and firmly, guided by one 2 inch guide pipe extending from the base elbow to the top of the station. Systems using guide cable in lieu of rigid guide bars or pipes shall not be considered acceptable. The sliding guide bracket shall be a separate part of the pumping unit, capable of being attached to standard 4 inch ANSI class 125 or metric DN100 pump flanges, so that the pump mounting is non proprietary, and any pump with a standard discharge flange can be mounted on the base assembly. Base or bracket assemblies with proprietary or non standard flange dimensions shall not be considered acceptable.

B. A field replaceable Nitrile (Buna-N) rubber profile gasket or o-ring shall accomplish positive sealing of the pump flange/guide rail bracket to the discharge elbow. Base assemblies which rely solely on metal to metal contact between the pump flange and discharge base elbow as a means of sealing are inherently leak prone, and shall not be considered equal. No portion of the pump shall bear directly on the floor of the sump.

2.4 PUMP CONSTRUCTION:

A. Major pump components shall be of gray cast iron, EN-GJL-250 (ASTM A-48, Class 35B) with smooth surfaces devoid of porosity or other irregularities. All exposed fasteners shall be stainless steel, 1.4401 (AISI type 316) construction. All metal surfaces coming into contact with the pumped media (other than the stainless steel components) shall be protected by a factory applied spray coating of zinc phosphate primer followed by a high solids two part epoxy paint finish on the exterior of the pump. The pump shall be equipped with an open lifting hoop suitable for attachment of standard chain fittings, or for hooking from the wet well surface. The hoop shall be stainless steel, 1.4401 (AISI 316), and shall be rated to lift a minimum of four times the pump weight.

B. Sealing: Design for the pump/motor assembly shall incorporate machined surfaces fitted with Nitrile (Buna-N) rubber O-rings. Sealing will be the result of controlled compression of rubber O-rings in two planes of the sealing interface. Housing interfaces shall meet with metal to metal contact between machined surfaces, and sealing shall be accomplished without requiring a specific torque on the securing fasteners. Rectangular cross sectioned gaskets requiring specific torque limits to achieve compression shall not be considered equal. No secondary sealing compounds shall be required or used.

C. Impeller: The ABS Contrablock Plus impeller shall be of gray cast iron, EN-GJL-250 (ASTM A-48, Class 35B). The impeller shall be single vane design, and shall be capable of passing a minimum of 3 inch diameter spherical solids as are commonly found in waste water. The impeller shall have a slip fit onto the motor shaft and drive key, and shall be securely fastened to the shaft by a stainless steel bolt which is mechanically prevented from loosening by a positively engaged ratcheting washer assembly. The head of the impeller bolt shall be effectively recessed within the impeller bore to prevent disruption of the flow stream and loss of hydraulic efficiency. The impeller shall be dynamically balanced to the ISO 10816 standard to provide smooth vibration free operation.

D. Pump Volute: The pump volute shall be single piece gray cast iron, EN-GJL-250 (ASTM A-48, Class 35B) non-concentric design with centerline discharge. Passages shall be smooth and large enough to pass any solids which may enter the impeller. Discharge size shall be as specified on the pump performance curve. The discharge flange design shall permit attachment to standard

ANSI or metric flanges/appurtenances. The discharge flange shall be slotted to accept both 3 inch ANSI class 125 (rotated 22.5 degrees) and metric DN100 flanged fittings. Proprietary or non standard flange dimensions shall not be considered acceptable. The minimum working pressure of the volute and pump assembly shall be 10 bar (145 psi).

2.5 PREMIUM EFFICIENCY MOTOR:

A. The Premium Efficiency motor shall meet efficiency standards in accordance with IEC 60034-30, level IE3 and NEMA Premium. Motor rating tests shall be conducted in accordance with IEC 60034-2-1 requirements and shall be certified accurate and correct by a third party certifying agency. A certificate shall be available upon request.
The Premium Efficiency motor shall be housed in a water tight gray cast iron, EN-GJL-250 (ASTM A-48, Class 35B) enclosure capable of continuous submerged operation underwater to a depth of 20 meters (65 feet), and shall have an IP68 protection rating. The motor shall be of the squirrel-cage induction design, NEMA type B, Premium Efficiency. The copper stator windings shall be insulated with moisture resistant Class H insulation materials, rated for 180ºC (356ºF). The stator shall be press fitted into the stator housing. The use of bolts, pins or other fastening devices requiring penetration of the stator housing is unacceptable. The rotor bars and short circuit rings shall be made of cast aluminum.

The motor shall be designed for continuous duty. The maximum continuous temperature of the pumped liquid shall be 40ºC (104ºF), and intermittently up to 50ºC (122ºF). The motor shall be capable of handling up to 15 evenly spaced starts per hour without overheating. The service factor (as defined by the NEMA MG1 standard) shall be **1.3.** The motor shall have a voltage tolerance of +/- 10% from nominal, and a phase to phase voltage imbalance tolerance of 1%. The motor shall be FM and CSA approved for use in NEC Class I, Division I, Groups C & D hazardous locations. The surface temperature rating shall be T3C. The motor shall meet the requirements of NEMA MG1 Part 30 and 31 for operation on PWM type Variable Frequency Drives.

The motor shall be capable of operating completely or partially submerged and shall be self cooling via the process fluid surrounding the motor. The motor shall have a NEMA Class A temperature rise for submerged service, providing cool operation under all operating conditions.

2.6 THERMAL PROTECTION:

A. Each phase of the motor shall contain a normally closed bi-metallic temperature monitor switch imbedded in the motor windings. These thermal switches shall be connected in series and set to open at 140ºC +/- 5ºC (284ºF). They shall be connected to the control panel, and used in conjunction with, and supplemental to, external motor overload protection.

2.7 MECHANICAL SEALS

A. Each pump shall be equipped with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies. The seals shall operate in a lubricant reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary industrial duty **silicon-carbide** seal ring and one rotating industrial duty **silicon-carbide** seal ring. The stationary ring of the primary seal shall be installed in a seal holding plate of gray cast iron EN-GJL-250 (ASTM A-48, Class 35B). The seal holding plate shall be equipped with swirl disruption ribs to prevent abrasive material from prematurely wearing the seal plate. The upper, secondary seal

unit, located between the lubricant chamber and motor housing, shall contain one stationary industrial duty **silicon-carbide** seal ring, and one rotating one rotating industrial duty **silicon-carbide** seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall not require routine maintenance, or adjustment, and shall not be dependent on the direction of rotation for proper sealing. Each pump shall be provided with a lubricant chamber for the shaft sealing system which shall provide superior heat transfer and maximum seal cooling. The lubricant chamber shall be designed to prevent overfilling, and to provide lubricant expansion capacity. The drain and inspection plug shall have a positive anti-leak seal, and shall be easily accessible from the outside of the pump. The seal system shall not rely upon the pumped media for lubrication and shall not be damaged when the pump is run dry. Lubricant in the chamber shall be environmentally safe non toxic material.

2.8 MECHANICAL SEAL PROTECTION SYSTEM:

A. The primary mechanical seal shall be protected from interference by particles in the waste water, including fibrous materials, by an active Seal Protection System integrated into the impeller. The back side of the impeller shall be equipped with a sinusoidal cutting ring, forming a close clearance cutting system with the lower submersible motor housing or seal plate. This sinusoidal cutting ring shall spin with the pump impeller providing a minimum of 75 shearing actions per pump revolution. Large particles or fibrous material which attempt to lodge behind the impeller, or wrap around the mechanical seal shall be effectively sheared by the active cutting system into particles small enough the prevent interference with the mechanical seal. The Seal Protection System shall operate whenever the pump operates, and shall not require adjustment or maintenance in order to function. Submersible pump designs which do not incorporate an active cutting system to protect the primary mechanical seal shall not be considered acceptable for wastewater service.

2.9 SEAL FAILURE EARLY WARNING SYSTEM:

A. The integrity of the mechanical seal system shall be continuously monitored during pump operation and standby time. An electrical probe shall be provided in a sensing chamber positioned between the primary and secondary mechanical seals for detecting the presence of water contamination within the chamber. The sensing chamber shall be filled with environmentally safe non toxic oil. A solid-state relay mounted in the pump control panel or in a separate enclosure shall send a low voltage, low amperage signal to the probe, continuously monitoring the conductivity of the liquid in the sensing chamber. If sufficient water enters the sensing chamber through the primary mechanical seal, the probe shall sense the increase in conductivity and signal the solid state relay in the control panel. The relay shall then energize a warning light on the control panel, or optionally, cause the pump shut down. This system shall provide an early warning of mechanical seal leakage, thereby preventing damage to the submersible pump, and allowing scheduled rather than emergency maintenance. Systems utilizing float switches or any other monitoring devices located in the stator housing rather than in a sensing chamber between the mechanical seals are not considered to be early warning systems, and shall not be considered equal.

2.10 SHAFT**:**

A. The pump shaft and motor shaft shall be an integral, one piece unit adequately designed to meet the maximum torque required at any normal start-up condition or operating point in the system.

The shaft shall have a full shutoff head design safety factor of 1.7, and the maximum shaft deflection shall not exceed .05 mm (.002 inch) at the lower seal during normal pump operation. Each shaft shall be stainless steel 1.4021 (AISI 420) material, and shall have a polished finish with accurately machined shoulders to accommodate bearings, seals and impeller. Carbon steel, chrome plated, or multi piece welded shafts shall not be considered adequate or equal.

2.11 BEARINGS:

A. Each pump shaft shall rotate on high quality permanently lubricated, greased bearings. The upper bearing shall be a deep grooved ball bearing and the lower bearings shall be a heavy duty double row angular contact ball bearing. Bearings shall be of sufficient size and properly spaced to transfer all radial and axial loads to the pump housing and minimize shaft deflection. L-10 bearing life shall be a minimum of 50,000 hours at flows ranging from ½ of BEP flow to 1½ times BEP flow (BEP is best efficiency point). The bearings shall be manufactured by a major internationally known manufacturer of high quality bearings, and shall be stamped with the manufacturer's name and size designation on the race.

2.12 POWER CABLE:

A. The power cables shall be sized according to NEC and CSA standards and shall be of sufficient length to reach the junction box without requiring splices. The outer jacket of the cable shall be oil and water resistant, and shall be capable of continuous submerged operation underwater to a depth of 65 feet.

2.13 CABLE ENTRY SYSTEM:

A. The cable entry system shall consist of submersible plug assembly which allows the cable be easily disconnected from the pump for service or replacement. Cable sealing shall be accomplished by a Nitrile compression grommet with both cylindrical and conical sealing surfaces, flanked by a stainless steel washer and an integrated strain relief. A brass (C3604) compression nut shall be threaded into to the cast iron EN-GJL-250 (ASTM A-48, Class 35B) cable plug housing, compressing the grommet ID to the cable while the grommet OD seals against the bore of the cable entry housing. Cable conductors shall be terminated in copper pin connectors which are separated and retained by a circular pin retainer fabricated from high dielectric strength Polyamid (30% GF). Each pin shall pass through its own hole in the pin retainer, maintaining perfect alignment with the mating pins in the motor body. The corresponding motor body pin assembly shall be manufactured from high dielectric strength Polyamid (30% GF), with copper connector pins. The pin assembly shall be sealed with an o-ring to prevent water entry into the motor, and retained in the motor housing bore via a retaining ring. Attachment of the plug assembly to the motor shall engage the corresponding copper pins, creating a complete circuit between the motor and cable. The plug assembly shall be fastened with stainless steel fasteners, and shall be sealed by an o-ring.

The cable plug and sealed entry system as part of the motor shall be FM and CSA approved for use in NEC Class I, Division I, Groups C & D hazardous locations. The system shall be anti wicking by design, and shall prevent any water that enters the cable through damage to the jacket from entering the motor.

2.14 TESTING:

A. Provide H.I. testing to 2B standards.

2.15 SPARE PARTS:

A. Provide (1) One, repair kit (mech seals, o-rings, and motor bearings), and hydraulic kit (impeller).

2.16 GUARANTEE:

A. All equipment shall be guaranteed against defects in material and workmanship for a period of one year from date of owner's final inspection and acceptance to the effect that any defective equipment shall be repaired or replaced without cost or obligation to the owner.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Install pumps according to the manufacturer’s written instructions.

B. Install pumps in location shown on plans, or location that will allow operators to remove pumps without conflict with other piping.

3.2 STARTUP SERVICE:

A. All tests shall be performed in the presence of a duly authorized representative of the Owner. If the presence is waived, certified results shall be provided by the Contractor.

B. Written notice of all tests shall be given two weeks in advance.

C. All test equipment shall be provided by the Contractor.

D. Engage a factory-authorized service representative to perform startup service for a minimum of one 8-hour day.

E. Complete installation and startup checks according to manufacturer's written instructions.

F. Start pumps without exceeding safe motor power:
   1. Start motors.
   2. Check general mechanical operation of pumps and motors.
   3. Test and adjust controls and safeties on both local and at the MCP for proper operation.
   4. Remove and replace damaged and malfunctioning components.
   5. Pump Controls: Set pump controls for automatic start, stop, and alarm operation as required for system application.
   6. Set field-adjustable switches and circuit-breaker trip ranges as indicated, or if not indicated, for normal operation.

3.3 DEMONSTRATION AND TRAINING:

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps for a minimum period of one 8-hour day.

B. Two (2) hard copies of the Operation and Maintenance manual along with an electronic version supplied on a flash drive shall be provided to the Owner’s representative upon completion of start up.

END OF SECTION 432618.20

SECTION 432618.21 – RDT FILTRATE DUPLEX PUMP CONTROL SYSTEM

PART 1 - GENERAL

1.1 It is the intention that this specification shall cover a complete Electrical Pump Control System as hereinafter described and all necessary appurtenances, which might normally be considered a part of the complete electrical system of this installation. All of the automatic control equipment is to be supplied by one manufacturer. It shall be factory assembled, wired, tested and covered by complete electrical drawings and instructions.

1.2 The "SENTRY" control system described hereinafter is a system as manufactured by USEMCO, Inc., Tomah, Wisconsin, and represented by Reiner Pump Systems, Inc. The naming of a manufacturer of equipment in this specification is not intended to eliminate competition or prohibit qualified manufacturers from offering equipment, but is to establish a standard of excellence for the material used, and to indicate a principle of operation desired.

1.3 SYSTEM COORDINATION AND SINGLE SOURCE RESPONSIBILITY:

A. The equipment provided shall be a completely integrated microprocessor based automatic control and monitoring system consisting of the required controller, power equipment, motor starters, level/flow and alarm monitoring equipment in a factory wired and tested assembly. The automatic control and alarm/monitoring system components shall be standard, catalogued, stocked products of the system supplier to assure one source responsibility, immediately available spare/replacement parts, proper system interconnections and reliable long term operation.

1.4 FIELD SUPERVISION:

A. The services of a factory trained, qualified representative shall be provided to inspect the completed installation, make all adjustments necessary to place the system in trouble free operation and instruct the operating personnel in the proper care and operation of the equipment.

1.5 GUARANTEE:

A. All equipment shall be guaranteed against defects in material and workmanship for a period of one year from date of owner's final inspection and acceptance to the effect that any defective equipment shall be repaired or replaced without cost or obligation to the owner.

PART 2 – PRODUCTS

2.1 WIRING:

A. The conductors shall be in complete conformity with the National Electric Code, state, local and NEMA electrical standards.

B. To ensure the safety of all personnel working with this equipment, as well as providing a simple means of tracing wires when troubleshooting, all wiring shall be color coded in strict accordance with the wiring diagrams furnished by the equipment supplier.

C. All job connections required for conveniently replacing control components shall be made at approved type terminal blocks with engraved Bakelite marker strips or similar approved means.

2.2 UL - INTRINSICALLY SAFE APPROVAL:

A. The control panel shall be constructed in compliance with Underwriters Laboratories Industrial Control Panels listing and follow-up service; utilizing UL listed and recognized components where applicable. The control panel shall bear the Underwriters Laboratories 508/698A serialized label relating to hazardous locations with intrinsically safe circuit extensions.

2.3 ENCLOSURE:

A. The described equipment shall be housed in a NEMA 4X stainless steel enclosure arranged for mounting on a support stand or building wall as shown on the drawings. The enclosure shall be constructed of not less than 14 gauge #304 stainless steel.

B. This weatherproof, tamper proof, rain-tight enclosure shall be designed specifically for mounting in an unprotected outdoor location. The enclosure shall be gasketed. It shall have a hinged front weather door with 3 point padlocking capability and an internally mounted hinged aluminum inner panel so that all the components normally actuated by operating personnel are accessible without opening the dead front and yet are not exposed to the elements or to unauthorized personnel.

1. All seams shall be continuously welded and ground smooth.
2. Door and body stiffeners shall be provided for extra rigidity.
3. Captivated door screws thread into sealed wells.
4. Heavy gauge continuous hinge.
5. Removable and reversible print pocket.
6. Oil resistant gasket and adhesive.

7. Collar studs shall be provided for mounting panel.

C. All field installed conduits, fittings or connections shall enter the enclosure through the bottom only for any outdoor enclosure.

D. All major components and sub-assemblies shall be identified as to function with laminated, engraved Bakelite nameplates or similar approved means.

2.4 INSULATION:

A. The enclosure shall be completely insulated on all interior surfaces with ½" thick AP/Armaflex expanded closed-cell flexible elastomeric thermal insulation, black in color. The insulation shall be neatly installed using Armaflex 520 adhesive.

2.5 POWER SUPPLY AND METERING:

A. The incoming service shall be 460 volts, 3 phase, 3 wire, 60 cycle.

2.6 MAIN CIRCUIT BREAKER

A. A molded case circuit breaker shall be provided as the main power disconnecting device for the control panel. The circuit breaker must have a minimum ampere interrupting capacity of (25,000-240 volt - 18,000-480 volt) symmetrical RMS amps. The circuit breaker shall be adequately sized for the pumps provided.

2.7 LIGHTNING ARRESTOR

A. A lightning arrestor shall be supplied in the control and connected to each line of the main power input terminals. The arrestor shall protect the control against damage due to lightning strikes on the incoming power line.

2.8 PHASE MONITOR

A. A solid state, phase sequence/failure and under voltage release relay shall be provided to ensure additional running protection for the pump motors. The relay shall be complete with an LED to indicate proper phase sequence, all phases in operation and voltage within limits. The relay shall also include an adjustable voltage monitor, be UL and CSA certified and be complete with automatic reset feature.

2.9 PUMP CIRCUIT BREAKER

A. A thermal magnetic circuit breaker shall be supplied as branch circuit protection for each pump motor. The circuit breaker must have a minimum ampere interrupting capacity of (25,000-240 volt – 18,000-480 volt) symmetrical RMS amps. The circuit breaker shall be operable through the operator's door of the enclosure.

B. The circuit breaker shall be properly sized to protect the motor conductors, motor starter and the motor against over current due to short circuit or grounds.

2.10 VARIABLE FREQUENCY DRIVE

A. This section provides specification for AC variable frequency drives or herein identified as VFD's for use with NEMA B design AC induction motors.

B. Any exceptions / deviations to this specification shall be indicated in writing and submitted with the quotation.

C. The products covered in this section shall be designed, manufactured, and tested in accordance with the latest applicable standards as follows:

1.	CSA 22.2 N14-95	Industrial control equipment
2.	EN 50178	Low Voltage Directive
3.	EN 60204-1	Safety of machinery-electrical equipment of machines. Part 1 - Specification for general requirement.
4.	EN 60950	Safety of information technology equipment including electrical business equipment.
5.	EN 61010-1	Safety requirement for electrical equipment for measurement, control, and laboratory use. Part 1 – general requirement.
6.	EN 61800-3	Electro Magnetic Compliance
7.	UL 508	Industrial control equipment.
8.	UL 508C	Power conversion equipment.
9.	IEC 664	Insulation coordination for equipment within low-voltage systems.
10.	IEC 60068-2-6	Environmental testing – Part 2 – Test Fc: vibration (sinusoidal).
11.	IEC 60068-2-27	Environmental testing. Part 2: Tests. Test Ea and guidance: Shock
12.	IEC 801-4	Electrical Fast Transient (Supplementary Wave).
13.	NEMA ICS6	Industrial control and systems enclosures.
14.	NEMA 250	Enclosures for electrical equipment.

D. Quality Assurance

1. The manufacturer of the VFD shall be a certified ISO 9001 and ISO 14000 facility.
2. The VFD, including its internal electronic thermal overload protection circuit, shall be UL and cUL Listed in accordance to UL 508C - Power Conversion Equipment.
3. UL / cUL labels shall be attached on the outside of each VFD as verification.
4. The VFD shall be designed in accordance with NEMA, IEC, EN, UL and CSA standards.
5. The VFD manufacturer shall have 20 years of experience, minimum, in the design, construction and application of variable frequency drives.
6. The VFD manufacturer shall have an existing service organization.
7. The manufacturer of the VFD shall have the ability to design and manufacture insulated gate bipolar transistors (IGBT) to be incorporated into the construction of the VFD.
8. The manufacturer of the VFD shall have the ability to evaluate any component failure at their own analysis lab. The services available shall include x-ray magnification of components, complete electrical testing, and the ability to analyze failures within the components.

E. General Description

1. The VFD shall convert the input AC mains power to an adjustable frequency and adjustable voltage as defined in the following sections.
2. The input power section shall utilize a full wave 6-pulse bridge design incorporating diode rectifiers. The diode rectifiers shall convert AC line power of fixed voltage and frequency to fixed DC voltage. This power section shall be insensitive to phase sequence of the AC line voltage.
3. The DC bus shall have external connections for external braking and allow for customer common DC Bus for multiple drive regeneration.
4. The output power section shall change fixed DC voltage to adjustable frequency AC voltage. This section shall utilize insulated gate bipolar transistors (IGBT's).

F. Construction

1. The VFD shall be rated UL Type 1 and shall be UL Listed as a plenum rated VFD.
2. The VFD shall employ built-in RS-485 communication via an RJ45 connection or terminal block.
3. The VFD shall employ built-in Modbus-RTU communication via a terminal block connection.

4. The VFD shall employ a standard control panel with built-in parameter copy functionality.
5. The VFD shall utilize one (1) connector slots for internally mounting plug-in options.
6. The VFD shall employ a removable control terminal block.
7. The VFD shall employ sink/source selectable control logic.
8. The VFD shall employ modular cooling fans – no tools required to exchange (up to 75Hp).
9. The VFD shall include a standard DC link reactor for ratings 100Hp and above.

G. Environmental Ratings

1. The VFD shall be designed to operate in the following Ambient Temperature range:
   a) Variable Torque and Constant Torque loads: –10C to +50C (14 to 122F).
2. The storage temperature shall be –20C to +65C (-4 to 149F), non-condensing. Applicable for short periods, such as during transit.
3. The maximum relative humidity shall be 90% at 50C (122F), non-condensing.
4. The VFD shall be rated to operate at altitudes less than or equal to 1000m (3280ft).
5. *The VFD shall be designed according to IEC 60068-2-6 to resist vibration.*

H. VFD Ratings

1. The VFD shall be designed for operation with the following input voltages.
   a) FR-F820, 1Hp to 75Hp: 170-242Vac 50HZ, 170-264Vac 60Hz, 200-240Vac (+10%/-15%).
   b) FR-F840, 1Hp to 800Hp: 323-528Vac 50/60Hz, 380-480Vac (+10%/-15%).
2. The speed range shall be from a minimum of 0.5 Hz to a maximum of 400Hz, adjustable by increments of 0.01Hz. Operation above 60Hz shall require programming changes to avoid over speeding the application.
3. The input voltage frequency range shall be 47.5 to 63 Hz.
4. The displacement power factor shall not be less than 0.93 with optional DC line reactor at 100% load factor. (DC reactor included as standard for VFD's 100HP and above.)
5. The efficiency of the VFD at 100% speed and load shall not be less than 95%.
6. The VFD shall conform to the European Union ElectroMagnetic Compatibility directive, CE labeled. The VFD shall meet product standard EN61800-3 for Second (2^{nd}) Environmental.

7. Frequency precision shall not be less than:
   a) Using analog input: Within +/- 0.2% of maximum output frequency. (25C +/-10C)
   b) Using digital input: Within +/- 0.01% of set output frequency.
8. The Over-current capacity shall be:
   a) Variable torque (LD): 120% for 1 min or 150% for 3sec, at 50C (continuous).
   b) Variable torque (SLD): 110% for 1 min or 120% for 3sec, at 40C (continuous).
9. The VFD shall minimize the audible motor noise through the use of an adjustable carrier frequency.
10. The Speed Control Range shall be:
    a) 20:1 while running between 3 and 60 Hz.

I. Protection

1. The VFD shall be UL 508C Listed for use on distribution systems with 65kArms available fault current, based upon the UL short-circuit test.
2. Upon power-up and before operational control is allowed to begin, the VFD shall check for valid operation of memory, pre-charge circuit, fan operation, and option board communication.
3. The VFD shall be protected against short circuits between the output phases & ground and the logic & analog outputs.
4. Once operational, monitoring shall continually take place and an abnormality will result in an alarm.
5. The following Circuit protection shall be allowed:

   a) The VFD shall be rated for use with the appropriate UL class fuse.
   b) Alternately, circuit breakers may be used, provided that they are listed or certified by an accredited electrical testing laboratory such as Underwriters Laboratories.

6. For a fault condition other than an internal fault, an auto restart function shall provide up to 10 programmable restart attempts. The programmable time delay before each restart shall range from 0 to 10 seconds.
7. The deceleration ramp of the VFD shall be programmable for normal and fault conditions. Stop modes shall include: dc injection braking, controlled deceleration to stop and coast to stop.
8. Upon loss of the analog speed reference signal:

   a) The VFD shall follow the programmed deceleration ramp to a controlled stop.
   b) Hold the VFD speed based upon the last good value and trigger a warning alarm.

9. The VFD shall have solid state I^2t protection that is evaluated in accordance with UL 508C. The minimum adjustment range shall be from 0 to 150% of the current output of the VFD.
10. The VFD shall include Metal Oxide Varistors (MOVs) wired to the incoming AC terminals.
11. STOP key on the keypad shall be functional at all time, drive mode insensitive.
12. The VFD shall be insensitive to input power phase sequence.
13. The VFD shall include 3 skip frequency ranges that can each be programmed with a selectable bandwidth of the user's choice. The skip frequencies shall allow independent programming for back-to-back or overlap.
14. The output frequency shall be parameter setting enabled to fold back when the motor is overloaded.
15. The VFD shall monitor the main circuit capacitors, control circuit capacitor, in-rush suppression circuit, and cooling fan and shall provide a pre-alarm so that maintenance can be scheduled.
16. The VFD shall include an output timer function so that peripheral equipment maintenance can be scheduled.
17. The VFD shall include parameter selectable input and output phase loss protection.
18. The VFD basic insulation level shall be tested based upon ANSI/IEEE C62.41-1999.

J. Adjustments and Configurations

1. The VFD shall be factory pre-set to operate most common applications.
2. Choice of four (4) types of acceleration and deceleration patterns shall be available: linear, S-curve shaped – two types, and backlash compensated.
3. The acceleration and deceleration ramps shall be individually adjustable from 0.00 to 3600 seconds.
4. The volts per hertz ratios shall be user selectable.
5. The VFD shall store the last eight (8) alarm faults and data at time of fault. The data shall include output frequency, output current, output voltage and VFD operation time at fault occurrence.
6. The VFD shall have user programmable DC injection braking to stop the motor's rotation. DC injection braking voltage is adjustable between 0 to 30% and up to 10 seconds of continuous operation.
7. Cooling fan control shall be selectable: Operates continuously during run operation, and dependent upon temperature at stop.
8. The VFD shall have adjustable accel/decel ramp profiles.
9. The VFD shall have the ability to start into a reverse rotating motor (anti-windmill) and achieve the set speed.
10. The VFD shall have two (2) different selectable settings for accel/decel times, torque boost, base frequency, stall prevention frequency and current, and output frequency detection functions.

11. The VFD shall have coast to stop functionality by parameter setting.
12. The VFD shall automatically compute the motor's slip compensation.
13. The VFD shall be able to limit motor rotation to only one direction.
14. The VFD shall have two (2) output current detection functions which are able to trigger individual alarms.

    a) Zero current detection level.
    b) High output current detection.

15. The VFD shall include two (2) parameters for user entry. (Unit or machine number, install date).

K. Operational Features

1. The VFD shall allow the motor to be switched in sequence to line power when operating at the base frequency.
2. The VFD shall be able to start into a rotating motor (any speed or direction) and accelerate (decelerate) to set speed without tripping or component loss.
3. There shall be a regenerative avoidance function to minimize the effect of opposite rotation of another fan within the same duct.
4. The VFD shall allow for automatic optimization of the VFD output, during accel/decal and constant speed, characteristic based upon the application and load.
5. The VFD shall incorporate PID control for process controls such as flow rate, air volume, or pressure.

    a) The VFD shall include programmable PID shutoff for energy savings in low speed region. (PID sleep)
    b) The VFD shall include the capability to monitor values of PID setpoint, process value, and deviation.
    c) The VFD shall include PID forward/reverse operation switchover by external signal.

6. The VFD shall allow for controlled deceleration to stop following an input power loss.
7. The VFD shall included automatic pump sequencing, which will allow the VFD to sequence up to 4 pumps across the line without additional controllers or software.
8. The VFD shall contain three (3) skip frequency ranges that can be programmed within a selectable range of 0-400Hz with a minimum bandwidth of 0.01Hz. Each skip range shall be independently programmable.
9. The VFD shall be able to perform bi-direction rotation following a –10 to +10Vdc input.

10. The VFD shall be able to run for at set hold time at the start frequency to smooth motor start.
11. Communication options include:
    a) RS-485 (standard).
    b) Or Approved Equal
12. The VFD output signals shall be able to be utilized in lieu of a remote output terminal of a programmable logic controller when the VFD is being controlled via RS 485 or network.

L. Operator Interface

1. Six (6) key Control Panel, with setting dial, shall be mounted on each drive and shall be removable & interchangeable regardless of the Hp rating. The customer control shall include the following functionality.

    a) Furnished with each VFD as standard.
    b) Batch parameter read, copy and verification functionality.
    c) Four (4) digit numerical display.
    d) Standard RS-485 communication through a RJ 45 port.
    e) Allows direct access for parameter changes.
    f) Includes an electronic parameter write disable feature.
    g) Stores/displays last four (4) alarm faults and data at time of fault. The data shall include output frequency, output current, output voltage and VFD operation time at fault occurrence.
    h) Forward, Reverse and Stop keys command normal starting and stopping as programmed when the VFD is in keypad control mode.
    i) Display of I/O and output terminal ON/OFF states.
    j) STOP key is functional at all time, drive mode insensitive.
    k) Can be mounted at a distance of 20 meters from the VFD.

2. Twenty-four (24) key parameter unit shall be available as an optional accessory and shall be removable & interchangeable regardless of the Hp rating. The customer control shall include the following functionality.

    a) Batch parameter read, copy and verification functionality.
    b) Standard RS-485 communication through a RJ 45 port.
    c) Alpha numeric LCD display.

        i. 4 Lines x 16 characters.
        ii. Adjustable LCD contrast.

    d) Includes a parameter write disable feature.
    e) Stores last eight (8) alarm faults and operation data (frequency, voltage, current, and VFD run time) at time of fault occurrence.
    f) Forward, Reverse and Stop keys command normal starting and stopping as programmed when the VFD is in keypad control mode.

g) STOP key is functional at all time, drive mode insensitive.
h) Can be mounted at a distance of 20 meters from the VFD.
i) Eight (8) languages available selectable among English, Japanese, German, French, Spanish, Italian, Swedish and Finnish.
j) Allows direct access for parameter changes individually, by function set and by user selected groups. Parameters can be listed by definition, factory default setting, or user changed values.
k) Calibration of frequency meter or bias/gain settings.
l) Arrow keys shall provide the ability to scroll through menus and screen, select or activate functions or change the value of a selected parameter.
m) HELP functionality shall include the following:

1) Monitoring of data: Running frequency, motor current, output voltage, set frequency, running speed (RPM), DC bus voltage, over-current load %, peak output current, peak dc bus voltage, input & output power used (kW), input and output signal state (ON or OFF).
2) Stores/displays last eight (8) alarm faults and data at time of fault. The data shall include output frequency, output current, output voltage and VFD operation time at fault occurrence.
3) Troubleshooting hints shall reference alarm definitions in plain English and point to applicable parameter settings.
4) Display of installed options and software version shall be available.

M. Control

1. The control power for the digital inputs and outputs shall be 24Vdc, selectable to sink or source. Optional 120Vac control power for the digital inputs and outputs shall be available.
2. All logic connections shall be furnished on a removable terminal strip.
3. External devices shall be able to be connected to the terminal strip for starting/stopping the VFD, speed control and indicating operation status.
4. Speed command input shall be by means of:

a) Keypad.
b) Analog input.
c) Serial communications.
d) Floating point input shall accept a three-wire input
e) There shall be three (3) parameter assignable analog inputs.
f) The selection consists of the following configurations: 0-5Vdc, 0-10Vdc, 4-20mA dc, -5 to +5 Vdc, and –10 to +10 Vdc.
g) Two (2) terminals shall be selectable for either voltage or current reference input.

h) Combinations of the above speed references can be selected and be switched via remote terminal.

5. There shall be twelve (12) logic inputs that are parameter assignable.

a) The selection consists of PTC, 15 preset speeds (up to four inputs), second functions, jog, current input selection, auto restart, external thermal relay, PID control, Advanced PID control to allow motor sequencing, PU to external switch-over.
b) Optional 3-digit BCD or 12-bit binary input terminals (3) shall be available as relay contact or open collector signals.

6. Output signals shall consist of:

a) Five (5) open collector outputs shall be available, which are parameter assignable and are optically isolated.

1) Can be selected for positive or negative logic.
2) The selection of assignments shall consist of: Running, Up to speed, Power failure/Under-voltage, Overload, Output frequency detection (first & second), Electronic over-current pre-alarm, PU mode, Inverter ready, Zero current detection, PID upper limit, PID lower limit, PID reverse rotation output, Commercial power supply switch over (MC1-MC3), Fan fault, Fin (heatsink) overheat pre-alarm, Power savings, Minor and Major fault outputs as standard selections.
3) The VFD's output terminals shall allow control through network commands.
4) Optional relay output contact signals (3) shall be available and selectable.
5) Optional digital outputs (5) shall be available and selectable through open collector terminals.

b) Pulse or Analog output signal shall be selectable in the form of either:

1) Analog output signal, 4-20mAdc.
2) Analog output signal, 0-10Vdc.

c) Two (2) Form (C) relay outputs with selectable Normally Open or Normally Closed alarm outputs shall be available.
1) Alarm terminals shall be individually parameter assignable.

N. Braking

1. The VFD shall provide terminals for adding an external braking unit to allow for dissipation of excessive electrical energy from the motor.
2. The following shall be available:

    a) DC dynamic braking – Including adjustable operation frequency, time and voltage.
    b) External line regeneration.
    c) Can be used for common bus systems for multiple drive regeneration.

O. Drive Options

1. Provide the following options/modifications to the VFD. All special features shall be factory mounted and wired within the VFD enclosure unless otherwise specified.

    -Input Line Reactors.
    -Fast acting input fusing.

P. Drive Operation

1. With the H-O-A switch in the "HAND" position, the drive shall be controlled by the manual speed potentiometer on the drive door.

2. With the H-O-A switch in "AUTOMATIC", the drive shall start from the automatic pump controller and its speed shall be controlled by a 4-20mA signal from this controller.

3. With the H-O-A switch in the "OFF" position, the run circuit will be open and the VFD will not operate.

2.11 PUMP DATA:

PUMP #	MOTOR HP	FLA
1	7.5 HP	9.9 Amp
2	7.5 HP	9.9 Amp

2.12 LIGHTING TRANSFORMER:

A. The panel shall include a dry type lighting transformer with a sufficient KVA rating to operate all 120-volt loads. A properly sized primary circuit breaker shall be

provided. This transformer may not be required if 120 volts can be obtained from the incoming service.

2.13 LIGHTING PANEL:

A. A four circuit lighting panel shall be supplied to provide individual circuit protection for the automatic control system and auxiliary station equipment. Breakers shall be provided for the following equipment:

1. SENTRY Controller.
2. GFI Outlet.
3. Condensation Heater.
4. Air Conditioner.

2.14 RECEPTACLE:

A. An operator's door mounted ground fault interrupter (GFI) type convenience receptacle rated at 15 amperes shall be supplied for the operating of trouble lights, drill, etc. It shall be protected by a separate 15-ampere trip rated circuit breaker.

2.15 CONDENSATION PROTECTIVE HEATER:

A. A 200-watt, 120 VAC thermostatically controlled, fan driven heater shall be supplied in the control panel to maintain a stable temperature and protect the electrical and electronic equipment from the harmful effects of condensation, corrosion and low temperatures.

2.16 VENTILATION:

A. An Air Conditioner shall be included to keep safe operating temperatures for the VFD's. The unit will have a stainless steel cabinet and **corrosion resistant** package.

B. Heat balance calculations shall be submitted with the shop drawings for the control panel showing that the system is capable of functioning without damage or premature control failures with all equipment in operation at the ambient temperatures specified.

C. Temperature calculations shall consider the following:

-VFD operating temperature ranges -10° to 50°C.
-Ambient temperature of -20°F to +104°F.

-Heating system designed for -20°F with no components in operation, windy conditions and no solar heat gain.
-Cooling system designed for +104°F with one drive and all components necessary for operation of the system, solar heat gain from bright sun and no wind.

2.17 SYSTEM OPERATION:

A. The control panel shall function as a duplex system. Operation of the pumps will be staged in a lead/lag sequence.

B. The primary control will consist of a "SENTRY" programmable controller, operator interface and submersible transducer as specified hereafter.

C. The back up control will consist of a duplex float controller. This controller will serve as a redundant system to the primary control and operate the pumps full speed.

2.18 USEMCO "SENTRY" PUMP CONTROLLER: (or Approved Equal)

A. The control system shall utilize standard "off the shelf" equipment. Job specific, "one-of-a-kind" customized software and hardware components will not be accepted. A standard system is defined, as one, which has published literature, is available at time of bid, with fully tested hardware and software, such that no development must be done beyond system configuration.

B. The equipment shall be protected from transient voltages and surges induced into the signal lines. The contractor shall provide a permanent earth ground connection to the panel ground lug in order to insure proper operation of transient protectors.

C. A microprocessor-based automatic pump and alarm control system shall be provided for each pumping station incorporating an industrial-grade, 16-bit CMOS microcomputer and associated elements suitable for achieving performance as hereinafter described. The controller will incorporate the following:

1. Internal diagnostics.
2. Real time clock calendar.
3. Floating-point math.
4. Battery back up.
5. Non-proprietary RTU communication.
6. (4) PID loops.

D. The system shall incorporate UL 508 Industrial Control Panel approved elements as required of all components of these project panels and be furnished with all necessary hardware and software to accomplish level-responsive pump and alarm operation with software specifically suited to this project.

E. All of the discrete I/O circuitry of the computer-based system shall be built to the IEEE 472 (1974) Surge Withstand Capability Standards. The automatic pump and alarm control system computer shall be the standard product of the control system manufacturer and specifically suited for this type of industrial control panel service. All job connections shall be a UL recognized clamp type barriered screw terminals accepting up to two AWG 14 conductors per terminal.

F. The variable speed drive equipment shall be programmed to respond to variations in the wetwell in a manner wherein the hydraulic requirement will be accommodated in the pumping program using simple menu-related operator interface routines.

G. Upon power-up, the Controller shall go through a timing routing, which allows the analog signal and display to stabilize before any control, or alarm outputs are enabled. After the stabilization period, the control circuits of the Controller shall be sequentially enabled on a time-step arrangement.

H. In addition to the time delay upon power-up, the differential-level control circuits shall each be forced to an off condition upon power up so that a level excursion will need to go past their turn-on elevation for them to operate.

I. An alternator shall operate the pumps in a First-on/First-off (FOFO) sequence and can be configured to sequence the pumps every start, every 24 hours, on the lowest run time or manually.

J. The alternator shall be capable of accepting pump failure and/or advance inputs and shall automatically transfer to the next pump sequence when failure condition input is sensed.

K. The alternator shall provide automatic transposing of the operating sequence of the control relays for the pumps on successive starts. The FOFO alternator sequencing shall operate such that the next load turned on is always the one that has had the longest opportunity to rest since its last operation.

L. It is the specific intention of this functional requirement that a standard programmable logic controller will be employed with features as herein described and be a fully integrated assembly. That is, the furnishing of similar functions using a proprietary controller with custom software, a multiplicity of set points, modules or extensive relay-timer logic to accomplish control sequences, etc., is specifically precluded by this specification and will not be acceptable.

M. Microprocessor based, programmable controller and operator interface shall provide all of the above controls and operations. A redundant back up float system shall be incorporated into the controller along with programmable automatic operation.

N. The automatic pump and alarm control shall employ a backlit LCD operator interface having a 320 x 240 pixel 7” 65K color display with touch screen. The

operator interface shall be IEC standard IP65F rated. The display also must support bar graphs or analog meters for wetwell levels, VFD #1, #2, speed indication. Operator interface must support screen scrolling and three levels of password protection. The interface must support a printer port.

O. A Configuration and Operations Manual will be included for the pump controller. The Manual shall include the following information as a minimum:

1. How to view and change between the various displays.
2. How to configure the controller.
3. How to display alarms.
4. How to display statuses.
5. Analog control set point adjustment.
6. Analog alarm set point adjustment.
7. How to view and reset pump run times.
8. How to view and reset pump start counters.
9. Security Password usage.
10. An example of programming values.
11. Adjustment of the real-time calendar/clock.
12. A listing of values programmed at the factory.
13. A worksheet for entering the values programmed in the field.

P. The intent of the specification is that a standard controller be provided, with standard documentation. A custom written Description of Operation is not acceptable.

Q. Controller Configuration

The pump controller operates on a 4-20mA input via a submersible transducer, ultrasonic transmitter or bubbler transmitter and shall be capable of being configured at the factory or jobsite to perform operating functions as described below. All configurations are password protected and shall be provided as a minimum as follows:

1. Simplex/Duplex Pump operation.
2. Clock hours (0-23) and minutes (0-59).
3. Calendar day of week (0-6 for Monday - Sunday).
4. Wetwell transducer rating (1.0-15.0 PSI).
5. Wetwell transducer offset.
6. Lag pump disable for non-additive systems.
7. Pump Alternation method.
8. Minimum 1 Pump Speed.
9. Minimum 2 Pump Speed.
10. Maximum 1 Pump Speed.
11. Maximum 2 Pump Speed.
12. Set Flush Cycle time of day.

13. Shut down, Alarm only or Lag pump designation upon Seal fail.
14. On board or Redundant float back up with weekly test feature.
15. Selectable pump fault for Low oil, Bearing overtemp or Check valve limit switch.

The pump controller will include the field adjustable delay timers. All timer settings are password protected and shall be provided as follows:

1. Pump 1 start fail delay (0-99 seconds).
2. Pump 2 start fail delay (0-99 seconds).
3. Lead pump start delay (0-99 seconds).
4. Lag pump start delay (0-99 seconds).
5. Lead pump stop delay (0-99 seconds).
6. Lag pump stop delay (0-99 seconds).
7. High Level alarm delay (0-99 seconds).
8. Low Level alarm delay (0-99 seconds).
9. Delay between calls (0.1-9.9 minutes).
10. Back up float pump down timer (1-5 minutes).
11. Back up float lag call timer (0-99 seconds).

The pump controller will include the field adjustable set points. Set points are password protected and provided as follows:

1. Lead pump start.
2. Lead pump stop.
3. Lag pump start.
4. Lag pump stop.
5. High Level Alarm.
6. Low Level Alarm.
7. Back up high float.
8. Flush Cycle on/off.

Provide menu driven screen displays for the following:

1. Wetwell Level.
2. Pump Run time values scaled to hours and tenths.
3. Pump Start counters.
4. Alarm Messages.

R. Flush Cycle:

The controller includes a flush cycle that will run the variable speed pumps at 100% in order to help clear any obstructions that may have developed by the pumps operating at lower velocities.

The flush cycle can be operated automatically daily or weekly or manually on demand as follows:

AUTO: Flush Cycle automatically controlled by using the preset set points.

1. Configure screen: Flush DAY (M-SU or Daily)
2. Configure screen: Flush HOUR (0-23, or Disable)
3. Modify Set points screen: Flush Cycle. ON and OFF setpoint/level

MANUAL: On demand

Start Flush Cycle button: Stops any running pump(s) to allow the w/w to fill to preset start level. Start all pumps and ramp speed to 100%. Pump will be stopped and flush cycle ended when the stop flush set point is reached.

Cancel Flush Cycle button: Aborts the Flush cycle immediately.

Indicators:
Event screen (Time & Date stamp)

1. FLUSH START – Message appears when the Auto or Manual feature activates the flush cycle.
2. FLUSH CANCEL – Message appears when the Manual/Cancel Flush Cycle is activated.
3. FLUSH PUMP DOWN – Pump(s) are being called to run during the flush cycle.
4. FLUSH CYCLE DONE – Message appears when a running pump is stopped at the end of a flush cycle or when a flush cycle is cancelled.

S. Operation:

At the start of any flush cycle, the first action is to stop any pump that may be running. The wet well will be allowed to fill to the Flush ON set point (note: the transducer Hi & Low Level alarms are disabled during a flush cycle). When the wet well level reaches the Flush ON setpoint, the Lead pump will be started and speed ramped up to 100%. Any additional pumps (lag, lag2) will be started following the pump start delay set for that pump. Those pump(s) speed will be ramped up to 100%. All pumps will operate at 100% until the Flush OFF set point is reached. All pumps will be stopped. The flush cycle is now complete. Note, if the flush OFF set point is set below the transducer Low Level alarm level, a Low Level alarm condition will now occur and will clear as the wet well level rise above the Low Level alarm set point.

2.19 BACKUP FLOAT CONTROL

A. A redundant backup float controller will be installed to operate the pumps and alarm on up to three up floats (High Level, Lead and Low Level) in the unlikely situation that the primary controller or transducer would fail. The backup controller is configured via the primary controller keypad and receives its data through the RS232 serial port using Modbus protocol. The controller will be configured as to the number of floats connected and float backup time delays settings. This information is stored in the backup controller and will operate as configured if the primary controller is failed or out of service. A dry telemetry contact is provided to indicate the backup controller is on. The controller shall be capable of being configured to operate the pumps and alarm on the backup floats as follows:

1. Three float operation (High Level, Lead and Low Level)

    a. When the high float is activated, the controller will call the lead pump and signal the alarm. If the float does not deactivate in a predetermined adjustable time the lag pump will also start. When the low float is deactivated, the pump(s) will be turned off. Each subsequent activation of the lead on float will turn the lead pump on and subsequent activation of the high float will turn the lag pump on. The alarm will remain on until manually reset.

2.20 ALARM MESSAGES:

A. In the event of an alarm condition the operator interface will display an alarm message. Press the ‘Alarm Ack’ button to acknowledge the alarm and ‘Alarm Reset’ button to clear the alarm. The following list of alarms shall be provided:

1. Low Level.
2. High Level.
3. Pump 1 Fail.
4. Pump 2 Fail.
5. Transducer Fail.
6. Seal 1 Fail.
7. Seal 2 Fail.
8. Motor 1 Overtemp.
9. Motor 2 Overtemp.
10. Pump 1 Fail (Configurable from external device).
11. Pump 2 Fail (Configurable from external device).
12. Backup Float Test Fail.

2.21 PUMP SEAL FAIL:

A. A seal failure relay specifically designed to interface with a contact closure from each of the specified pumps will be included. A Seal Fail alarm message will be displayed on the controller. In addition the controller can be configured to shut down the pump or designate it to the lag position until the condition is corrected.

2.22 OVER TEMPERATURE PUMP PROTECTION:

A. Over temperature protection relays shall be provided in the control panels to operate in conjunction with the over temperature switch in each pump motor. The controller shall provide an Overtemp Fail alarm message and pump lockout of operation upon occurrence of high temperature. The circuitry shall also include a reset push button on the controller for manual reset capability.

2.23 SELECTOR SWITCHES:

A. A 22 mm oil tight three-position, “Hand-Off-Automatic” selector switch shall be flush-mounted on the operator’s door of the control panel for the operation of each VFD. This selector switch shall operate the VFD when it is in either the "Hand" position or the "Automatic" position, and the automatic control system is calling for the operation of the equipment in the manner as herein described.

2.24 STATUS INDICATORS:

A. A 22 mm oil tight green "Pump Running" pilot light shall be flush-mounted on the operator’s door of the control panel. This pilot light shall be operated from a respective run contact. The pilot light shall have a replaceable bulb.

2.25 WEATHERPROOF ALARM LIGHT:

A. A weatherproof 40-watt alarm light assembly including a high impact resistant lexan red lens shall be included. The alarm light bulb shall be replaceable from inside the control panel without having to remove the weatherproof red lens from the panel.

B. A solid-state flasher shall be included to strobe the alarm light for any of the specified alarm conditions.

2.26 WEATHERPROOF ALARM HORN:

A. A weatherproof audible U.L. Listed alarm horn shall be provided. The horn will be side mounted to the control panel, and shall operate on 115 VAC with a typical 95

DB output. An alarm silence push button shall be included, mounted on the operator's door.

2.27 SUBMERSIBLE WETWELL LEVEL SENSING TRANSDUCER:

A. A submersible level transducer shall sense the liquid level of the wetwell. The transducer shall be a 2-wire type to operate from a supply voltage of 10.5 to 24 VDC instrumentation signal in direct proportion to the measured level excursion over a factory-calibrated range of zero to 11.5 feet of water. It shall be of the head-pressure sensing type, suitable for continuous submergence and operation and shall be installed in accordance with manufacturer's instructions. The bottom diaphragm face (2½" diameter minimum) of the sensor shall be installed 6 inches above the floor.

B. The transducer shall incorporate a diffused silicon semiconductor transducer element to convert the sensed pressure to a corresponding electrical value. The sensed media shall exert its pressure against the diaphragm, which flexes minutely so as to vary the proximity between an internal ceramic diaphragm created between the two surfaces. A stable, hybrid, operational amplifier assembly shall be incorporated in the transducer to excite and demodulate the sensing mechanism. The transducer shall incorporate laser trimmed, temperature compensation and high quality components and construction to provide a precise, reliable, stable output signal directly proportional to the sensed pressure over a factory-calibrated range.

C. The pump controller shall connect to the submersible transducer through an intrinsically safe module. The module shall provide an intrinsically safe interface for the sensor located in a hazardous area rated Class 1 Group C and D. The intrinsic safety barrier shall be UL listed.

2.28 SHOP DRAWINGS:

A. A complete set of drawings shall be supplied to ensure successful installation and operation of the control system. The shop drawings shall consist of all of the following:

1. Sufficient detail to evaluate compliance with these specifications.
2. A detailed component list including manufacturer and catalog number.
3. A custom-wiring diagram for this specific application to facilitate and ensure accurate field connections to the control panel by electrical installation personnel.
4. A description of operation for the control system.
5. An enclosure dimension print.

PART 3 – EXECUTION

3.1 EXAMINATION:

A. Install pump control panel according to the manufacturer’s written instructions.

B. Install pump control panel in location shown on plans and location that will allow operators to access panel without conflicts.

3.2 STARTUP SERVICE:

A. Engage a factory-authorized service representative to perform startup service for a minimum of one 4-hour day.

B. Complete installation and startup checks according to manufacturer's written instructions.

C. Start pumps without exceeding safe motor power:

1. Start motors.
2. Check general mechanical operation of pumps and motors.
3. Test and adjust controls and safeties on both local and at the MCP for proper operation.
4. Remove and replace damaged and malfunctioning components.
5. Pump Controls: Set pump controls for automatic start, stop, and alarm operation as required for system application.
6. Set field-adjustable switches and circuit-breaker trip ranges as indicated, or if not indicated, for normal operation.

3.3 DEMONSTRATION:

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps for a minimum period of one 4-hour day.

B. Operation and Maintenance Manuals: Two (2) hard copies of the Operation and Maintenance manual along with an electronic version supplied on a flash drive shall be provided to the Owner’s representative upon completion of start up.

END OF SECTION 432618.21

SECTION 434183 – LIQUID CHEMICAL STORAGE TANKS

PART 1 - GENERAL

1.0 DESCRIPTION

A. This specification covers upright, single and double wall, flat bottom storage tank assemblies. All double wall tank assemblies shall consist of one cylindrical inner primary tank and one blended form octagonal outer secondary tank. Each tank is molded in one-piece seamless construction by rotational molding (laminated or fabricated tanks will not be accepted). The tanks are designed for above-ground, vertical installation and are capable of containing chemicals at atmospheric pressure. The assembly shall be designed to prevent rainwater from entering the containment tank. The design shall allow direct primary tank base retention for up to seismic conditions per IBC code requirements. The containment tank shall be designed to hold a minimum of 115% of the normal fill capacity of the primary tank. Included in this specification are requirements for material properties, design, construction, dimensions, tolerances, workmanship, and appearance. Tank capacities are from 35 gallons up to 1,500 gallons.

B. This specification does not cover the design of vessels intended for use at pressures above or below atmospheric conditions. It is also not for vessels intended for use with liquids heated above their flash points, temperatures above 130 degrees Fahrenheit for Type II materials. (Note: See 1.08 A.2. for chemicals being stored above 100 degrees F)

C. Contractor shall supply and install all materials, equipment, appurtenances, specialty items, and services required to provide an upright, double wall, flat bottom, closed top, polyethylene storage tank for storage of the chemical application(s) described in Table 1. Each tank is to be molded in one-piece seamless construction according to ASTM D 1998 (laminated or fabricated tanks will not be accepted) and will be capable of storing the chemical application at atmospheric pressure.

1.1 RELATED SECTIONS

A. Division 40 for chemical piping requirements.

B. Division 41 for remote fill box specifications.

1.2 REFERENCES, CODES, AND STANDARDS

A. ASTM (American Society for Testing and Materials) Standards:

1. D618 Conditioning Plastics and Electrical Insulating Materials for Testing
2. D638 Tensile Properties of Plastics
3. D790 Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
4. D883 Definitions of Terms Relating to Plastics

5. D1505 Density of Plastics by the Density-Gradient Technique
6. D1525 Test Method for Vicat Softening Temperature of Plastics
7. D1693 Test Method for Environmental Stress-Cracking of Ethylene Plastics
8. D1998 Standard Specification for Polyethylene Upright Storage Tanks
9. D2765 Degree of Crosslinking in Crosslinked Ethylene Plastics as Determined by Solvent Extraction
10. D2837 Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials
11. D3892 Practice for Packaging/Packing of Plastics
12. F412 Definitions of Terms Relating to Plastic Piping Systems

B. ARM (Association of Rotational Molders) Standards: Low Temperature Impact Resistance (Falling Dart Test Procedure)

C. ANSI Standards: B-16.5 Pipe Flanges and Flanged Fittings

D. OSHA Standards: 29 CFR 1910.106 Occupational Safety and Health Administration, Flammable and Combustible Liquids

E. IBC CODE: International Building Code 2021 Edition

F. CBC Code: California Building Code 2022 Edition

G. NSF/ANSI Standard 61 – Drinking Water System Components (Type II resin)

H. 40 CFR-264.193

I. Chemical compatibility shall be according to the following chemical resistance guides:

Compass Publications - Pruett, Kenneth M., “Chemical Resistance Guide for Plastics”

Pruett, Kenneth M., “Chemical Resistance Guide for Metals and Alloys”

Pruett, Kenneth M., “Chemical Resistance Guide for Elastomers III”

1.3 SUBMITTALS

A. Drawings and Data: The manufacturer’s shop drawings shall be approved by the engineer or contractor prior to the manufacturing of the tank(s). Data and specifications for the equipment shall include, but shall not be limited to the following submittals.

B. Contractor shall submit for review sufficient literature, detailed specifications, and drawings to show dimensions, materials used, design features, internal construction, weights and any other information required by the ENGINEER for review of storage tanks and accessories.

C. Information to be included with the submittals is specified below:

1. Shop drawings for the tanks shall include as a minimum the following:
    a. Service Conditions: Chemical environment and temperature
    b. Statement that fabrication shall be in accordance with ASTM D 1998, where applicable.
    c. Sizing and description of the fittings and accessories for each tank that are to be supplied by the tank manufacturer.
    d. Layouts and assembly schedules for each tank identifying the location and elevation from the bottom of the tank for all connections and appurtenances supplied by the tank manufacturer.

2. Resin - A copy of the resin data sheet from the resin manufacturer for the tank is to be supplied and the tank manufacturer is to certify that it will be the resin used in the manufacture of the tank. Verification may be required if the resin is to be FDA or NSF 61 listed.

3. Wall thickness - Prior to the manufacture of the tank the designed wall thickness audit is to be supplied based upon ASTM D1998 @ 100 degrees F. (Note: See 1.08 A.2 for chemicals being stored above 100 degrees F)

4. Tank restraint – If supplied, the drawings and calculations for the system are to be provided. Note: Wet stamped or site specific drawings and calculations may be required.

5. Supporting information on fittings and accessories to be supplied; heat system, insulation, mastic coating, etc.

6. Technical Manuals: The tank manufacturer's "Guideline for Use & Installation" is to be submitted for review.

7. Installation certificate: Once installed, the installer is to certify that the tank system has been installed according to the tank manufacturer's Guidelines for Use & Installation.

8. Manufacturer's warranty

9. Manufacturer Qualifications: The manufacturer is to have rotationally molded polyethylene tanks based upon ASTM D 1998 utilizing Type II resins for the last 10 years.

10. Factory Test Report: Upon completion of the tank the manufacturer's inspection report is to be supplied for each tank.

    a. Verification of wall thickness (See 1.3.D)

    b. Impact test (See 1.3.C)

    d. Hydrostatic test (See 1.3.E.)

    e. Verification of fitting placement

    f. Visual inspection (See 1.3.F)

    g. Verification of materials

1.4 QUALITY ASSURANCE & TEST METHODS

A. The tanks of the same material furnished under this Section shall be supplied by a manufacturer who has been regularly engaged in the design and manufacturing of rotationally molded polyethylene chemical storage tanks using cross-linked and high-density linear polyethylene tanks for over ten years.

B. Dimensions and Tolerances

    1. All dimensions will be taken with the tank in the vertical position, unfilled. Tank dimensions will represent the exterior measurements.

    2. The tolerance for the outside diameter, including out of roundness, shall be per ASTM D1998.

    3. The tolerance for fitting placements shall be +/- 0.5 in. in elevation and 2 degrees radial at ambient temperature.

C. Low Temperature Impact Test (copy of the test report will be provided if ASTM documents are ordered)

    1. Test specimens shall be taken from fitting location areas.

    2. Test specimens shall be conditioned at (- 40) degrees Fahrenheit for a minimum of 2 hours.

    3. The test specimens shall be impacted in accordance with the standard testing methods as found in ASTM D1998. Test specimens < ½" thickness shall be tested at 100 ft. lb. Test specimens > ½" thickness shall be tested at 200 ft. lb.

D. Ultrasonic Tank Thickness Test (copy of the test report will be provided if ASTM documents are ordered)

    1. All primary tanks 2000 gallons or larger shall be measured for tank wall thickness at 6", 1ft., 2ft. and 3ft. on the tank sidewall height at 0° and 180° around the tank circumference

with 0° being the tank manway and going counterclockwise per ANSI standard drafting specifications. A copy of this test report can be ordered when placing the original tank order. All tanks shall meet design thickness requirements and tolerances.

2. Tanks smaller than 2000 gallons are only periodically measured at the start of a production run or after any design changes. Customers can place an order for tank wall thickness measurements on smaller tank sizes when placing the original order. A copy of the test report shall be provided.

E. Factory Hydrostatic Water Test

1. The hydrostatic water test shall consist of filling the primary tank to brim full capacity for a minimum of four hours and conducting a visual inspection for leaks. A copy of the test results shall be provided.

F. Workmanship

1. The finished tank wall shall be free, as commercially practicable, of visual defects such as foreign inclusions, air bubbles, pinholes, pimples, crazing, cracking and delamination that will impair the serviceability of the vessel. Fine bubbles are acceptable with Type II tanks to the degree in which they do not interfere with proper fusion of the resin melt.

2. All cut edges where openings are cut into the tanks shall be trimmed smooth.

1.5 DESIGN REQUIREMENTS

A. A. The minimum required wall thickness of the cylindrical shell at any fluid level shall be determined by the following equation but shall not be less than 0.187 in. thick.

T = P x O.D./2 SD = 0.433 x S.G. x H x O.D./2 SD

T = wall thickness
SD = hydrostatic design stress, PSI
P = pressure (.433 x S.G. x H), PSI
H = fluid head, ft.
S.G. = specific gravity, g/cm^3
O.D. = outside diameter, in.

B. The hydrostatic design stress shall be determined by multiplying the hydrostatic design basis, determined by ASTM D2837 using rotationally molded samples, with a service factor selected for the application. The hydrostatic design stress would be ≤ 660 PSI at 73 degrees Fahrenheit for Type II materials based the resin density. In accordance with the formula in 1.08 A., the tank shall have a stratiform (tapered wall thickness) wall. In no case shall the wall thickness be less than the minimum allowed per calculation of ASTM D1998.

C. The hydrostatic design stress shall be derated for service above 100 degrees Fahrenheit and for mechanical loading of the tank.

D. The standard design specific gravity shall be 1.9.

E. The minimum required wall thickness for the cylinder straight shell must be sufficient to support its own weight in an upright position without any external support. Secondary containment tanks shall be designed per the manufacturer's standard containment thickness requirements. The secondary containment shall be configured to allow shipment of the primary tank inside of the secondary tank. The shipment shall be done without the aid of additional spacer blocks which can be lost during shipment causing tank damage.

F. The top head must be integrally molded with the cylinder shell. The minimum thickness of the top head shall be equal to the top of the straight wall. The primary tank top shall be configured to prevent rainwater from entering the secondary containment tank. The top head of tanks with 550 or more gallons of capacity shall be designed to provide a minimum of 1300 square inches of flat area for fitting locations. The primary tank shall be keyed to the secondary tank preventing primary tank rotation. The secondary containment shall have 115% of the normal fill capacity of the primary tank.

G. Tanks with 550 or more gallons of capacity shall have a minimum of 3 lifting lugs integrally molded into the top head. The lifting lugs shall be designed to allow erection of empty primary and secondary tanks. Tanks shall be capable of being lifted into position as a unit (primary and secondary tanks). Tanks sized from 275 to 500 Gallons shall have molded in fork-lift channels in the base of the containment tank.

PART 2 – PRODUCTS

2.0 GENERAL TANK INFORMATION

A. Contractor shall supply and install all materials, equipment, appurtenances, specialty items, and services required to provide an upright, single and double wall, flat bottom, closed top, polyethylene storage tank for storage of the chemical application(s) described in Table 1.

TABLE 1 – CHEMICAL TANK SCHEDULE

TANK ID	CHEMICAL	QUANTITY	VOLUME (GAL)	DESCRIPTION
ST-01	SODIUM HYDROXIDE	1	500	All ST Tanks are Dual containment, All DT Tanks are single containment HDLPE, vented manway, PRV vent, discharge, siphon, suction, ultrasonic level indicator, leak detection sensor (500-gal tank) hydrostatic testing, ASTM QA documentation. 304SS Nameplate with welded on mounting block. Manufactured by Snyder Tanks O.A.E
DT-01	SODIUM HYDROXIDE	1	250	
ST-02 ST-03	SODIUM HYPOCHLORITE	2	500	
DT-02	SODIUM	1	250	

	HYPOCHLORITE			
DT-03 DT-04	CITRIC ACID	2	330	ULINE MODEL H-4420 O.A.E

*DT = Day Tanks; ST = Storage Tanks

2.1 TANK FITTINGS

A. Fittings – Threaded Bulkhead

1. Threaded bulkhead fittings are available for above liquid installation depending on the tank diameter and the placement of the fitting in the tank. Fittings must be placed away from tank knuckle radius' and flange lines. Consult manufacturer for placement questions. The maximum allowable size for bulkhead fittings placed on a curved cylindrical section of tanks 48 in. to 142 in. in diameter is 2 inch. Tank wall thickness must be considered for bulkhead fitting placement. The maximum wall thickness for each fitting size is shown below.

Fitting Size	Maximum Wall Thickness
1/2 in.	2 in.
3/4 in.	2 in.
1 in.	2 in.
1 1/4 in.	2 in.
1 1/2 in.	2 in.
2 in.	2 in.
3 in.	2.125 in. (Flat Surface Only)

2. The bulkhead fittings shall be constructed of PVC, PP, or other specified material. Gaskets shall be a minimum of 1/4" thickness and constructed of 40-50 durometer EPDM, 60-70 durometer Viton®, or other specified material.

B. Fittings - Bolted Double 150 lb. Flange Fittings

1. Bolted double flange fittings are available for below liquid level installation for sizes 2 in. through 4 in. depending on the placement of the fitting in the tank. Fittings must be placed away from tank knuckle radius' and flange lines. Consult SII for placement questions. Bolted double flange fittings provide the best strength and sealing characteristics of any tank fitting available. Allowable fittings sizes based on tank diameter for curved surfaces are shown below.

Tank Diameter	Maximum Bolted Fitting Size Allowable
48 in. - 86 in.	3 in.
90 in. - 102 in.	6 in.
120 in. - 142 in.	8 in.

2. The bolted double flange fitting shall be constructed with 2 ea. 150 lb. flanges, 2 ea. 150 lb. flange gaskets, and the correct number and size of all-thread bolts for the flange

specified by the flange manufacturer. The flanges shall be constructed of PVC Type I, Grade I, or other specified material. Gaskets shall be a minimum of 1/4" thickness and constructed of 40-50 durometer EPDM, 60-70 durometer Viton® or other specified material. There shall be a minimum of 4 ea. full thread bolts. The bolts may have gasketed flanged metal heads or bolt heads encapsulated in Type II polyethylene material. The encapsulated bolt shall be designed to prevent metal exposure to the liquid in the tank and prevent bolt rotation during installation. The polyethylene encapsulation shall fully cover the bolt head and a minimum of 1/4" of the threads closest to the bolt head. The polyethylene shall be color coded to distinguish bolt material (white - 316 S.S., yellow - Hastelloy C276, green - Titanium). Each encapsulated bolt shall have a gasket to provide a sealing surface against the inner flange.

3. Standard orientation of bolted double flange fittings shall have bolt holes straddling the principal centerline of the tank in accordance with ANSI/ASME B-16.5 unless otherwise specified.

C. Fittings - Bolted Stainless Steel Fittings

1. Bolted stainless steel fittings are available for below liquid level installation depending on the tank diameter and the placement of the fitting in the tank. Fittings must be placed away from tank knuckle radius' and flange lines. Consult SII for placement questions. Allowable fittings sizes based on tank diameter for curved surfaces are shown below.

Tank Diameter	Maximum Bolted Fitting Size Allowable
48 in.	3 in.
64 in. - 142 in.	4 in.

The bolted stainless steel fittings shall allow tank wall thickness up to 2 1/2 in.

2. The bolted stainless steel fittings shall be constructed with a minimum of 4 fully threaded 3/8 in. studs. Each fitting shall have two gaskets and two flanges. One gasket shall be compressed between the inside of the tank wall surface and the inside flange of the fitting. The other gasket shall be compressed between the outside tank wall surface and the outside flange of the fitting. The stainless steel fittings come standard with female pipe threads on both the inner and outer flanges. Other threading arrangements may be specified. The fittings shall be constructed of Type 316 stainless steel. Gaskets shall be a minimum of ¼" thickness and constructed of 40-50 durometer EPDM, 60-70 durometer Viton® or other specified material.

3. The UFO shall provide a flexible containment seal between the inner primary tank and the outer secondary containment tank. This fitting outlet when used in combination with fittings as per sections 2.01 C and D provides access for connecting piping to the inner primary tank while maintaining containment integrity between the inner primary tank and the outer secondary containment tank. This fitting outlet may be used for 2, 3, and 4 in. fitting sizes.

D. Fittings - Siphon Tube

1. Siphon tubes may be added to the fittings specified in sections 2.01 C and D. A siphon tube will allow these fittings, when used as drainage fittings, to provide additional tank drainage.

E. Vents

1. Each tank must be properly vented for the type of material and flow rates expected. Vents must comply with OSHA 1910.106 (f) (2) (iii) or other accepted standard. All tanks must be vented for atmospheric pressure as well as any pressure created by filling and emptying the tank. Some applications may require a sealed tank with a vent line going to a scrubber system for proper chemical safety. Venting equipment should be sized to limit pressure or vacuum in the tank to a maximum of 1/2" of water column (0.02 psi). U-Vents are offered in sizes from 1 in. to 6 in. with or without mesh insect screening. U-Vents with mesh screening may require additional sizing due to reduced air-flow rates. Consult the manufacturer for necessary venting and placement information.

2. All u-vents shall be constructed of PVC or other specified materials.

3. When a tank is being filled from a pressurized tanker truck or rail car steps need to be taken to avoid pressurizing the tank. The tank may require a secondary surge protection lid to avoid any pressure build up. The surge protection lid is to be a 14” or 18” hinged and be design that it is self-closing.

4. To avoid the air surge and over-pressurization from a tank being filled from a pressurized tanker truck or rail car, the 18” (26” x 11.7”) polyethylene mushroom vent could be used. The mushroom vent is rotationally molded with Type II, HDLPE. The vent is to be attached to the tank with (8) screws and a bead of silicone sealant or threaded designs quarter-twist into an 18” threaded manway ring (replaces manway). The underside of the vent has 1/8” poly mesh insect screen. The mushroom vent requires a 19” diameter flat surface on the tank for installation or a tank with an existing 18” threaded manway.

F. Flange Adapters

1. Flange adapters may be purchased as optional equipment to adapt threaded or socket fitting outlets to 150 lb. flange connections for connection to piping system components. Flange adapters are available in PVC. Flange adapter construction shall utilize schedule 80 components in sizes ranging from ¾” to 8” depending on material required.

G. Flexible Connections

1. All tank fitting attachments shall be equipped with flexible couplers or other movement provisions provided by the tank customer. The tank will deflect based upon tank loading, chemical temperature and storage time duration. Tank piping flexible couplers shall be designed to allow 4% tank design movement. Movement shall be considered to occur both outward in tank radius and downward in fitting elevation from the neutral tank fitting placement.

2. The flexible connection is to be manufactured of the same material as the tank or a compatible material approved by the project engineer. If an elastomer flexible connection is used control bolts are required if recommended by the manufacturer. The flexible connection is to be designed for a minimum of 4% tank movement. The flexible connection is to be designed with 150# flange connections to allow for attachment to the tank and the piping system. The flexible connection is to be attached as close as possible to the tank to reduce stress.

2.2 TANK ATTACHMENTS

A. Level Indication

1. Ultrasonic Level Indicator

a. The ultrasonic enclosure is to be an all plastic design with a NEMA 4X rating.
The ultrasonic transducer is to have a 12" dead band and beam with a 20 ft range. The supply voltage can be 110, 220 VAC or 24 VDC. The connection to the tank is to be 2" NPT.

b. The ultrasonic level indicator shall provide a visual display of liquid level in the tank showing gallonage in measurement of hundreds of gallons along with 4-20 mA output for other alarm or control systems as well as four independent contacts capable of handling 10 amps each. Each contact can be programmed to operate in different opening and closing methods (7 modes). Contacts can be used to control pumps, valves, alarms, etc.

B. Leak Detector Unit

1. The leak detector unit shall consist of a proximity sensor, a welded 2 in. fpt connection, a 2 in. bung plug with a ¾ in strain relief, and an indicator box. The sensor is placed in the interstitial space between the primary and secondary tanks approximately 1 in. above the tank bottom. The indicator box shall be NEMA 4 rated and factory pre-wired for 110 VAC power. All connections shall be labeled to prevent errors in field installation.

2. Audible Model - Shall be supplied with audible and visual alarms. Additionally, it shall include a normally open (NO)or normally closed (NC) auxiliary outputs that can be wired to another alarm source such as a PLC or auto-dialer.

C. Threaded Manways and Fill Caps

1. Manways are available in an 18 in. vented or non-vented threaded design or hinged style (minimum opening diameter of 15 in.) and a 24 in. vented or non-vented threaded or hinged style (minimum opening diameter of 22 in.) on various tank sizes. Check the manufacture's specification drawing for availability and position.

2. All caps and manways shall be constructed of polyethylene material.

D. Down Pipes and Fill Pipes

1. External Fill / Down Pipes

a. External fill pipes shall be prepared per the customer approved drawings and specifications. All external fill pipes shall be supported at 3 ft. maximum intervals with a support structure independent of the tank (ground supported). All designs shall be done according to the specific needs of the customer.

b. All external fill pipes shall be constructed of PVC or other specified materials.

2. Internal Fill / Down Pipes

    a. Internal down pipes shall be prepared per the customer approved drawings and specifications. All internal down pipes shall be supported at 5 ft. maximum intervals with a support structure welded to the inside of the primary tank (only available in tanks constructed with Type II resin). The support design may utilize a PVC clamp or other specified materials for support. All designs shall be done according to the specific needs of the customer.

    b. All internal down pipes shall be constructed of PVC or other specified materials

E. Nameplates

1. Manufacturer shall provide a 304 SS nameplate with each tank. Manufacturer shall provide the Contractor with a submittal drawing for review and approval prior to shipment. The contents of the nameplate shall include:

    a. Volume of Tank and Tank Type
    b. Material of Tank and Specific Gravity
    c. Material Stored in Tank
    d. Manufacturer
    e. Model Number
    f. Serial Number

2.3 WARRANTY

A. The tank shall be warranted for three years in regard to defects in materials and workmanship. The warranty on fittings and accessories supplied by the tank manufacturer will be for one year. The warranty will begin at time of shipment.

B. Snyder Industries may offer extended warranties on tanks (up to a maximum of 5 years) in regard to defects in materials and workmanship in certain applications or as a purchased option. Please consult Snyder Industries if you have any questions regarding extended warranty coverage and/or requirements.

2.4 MARKING, PACKING AND PACKAGING

A. The tanks shall be marked to identify the product, date (month and year) of manufacture, capacity, and serial number. The tank shall be shipped with a 3 of 9, HRI bar code label containing tank description, manufacturing order number, part number, serial number, manufacturer, and date.

B. The proper caution or warning signs as prescribed by OSHA standard 29 CFR 1910.106 shall be customer determined and supplied.

C. All packing, packaging, and marking provisions of ASTM Practice D3892 shall apply to this standard.

D. Customer specified labeling is available.

E. Tank shrink wrapping and bagging is available upon customer request.

F. All fittings that do not interfere with tank shipment shall be installed unless otherwise specified. Fittings and accessories that interfere with tank shipment or could be broken during shipment are shipped separately.

G. Permanent Labels:

1. Manufacturer shall include engraved stainless steel identification plate. Must be ordered by contractor.

2. National Fire Protection Association label specifically coded for the tank contents in accordance with NFPA 30. (to be supplied by the contractor separately).

3. Stencil the chemical label on to the tank wall to be clearly visible from outside the tank enclosure. Must be ordered by the contractor through the chemical supplier.

2.5 FACTORY TESTING

A. Material Testing

1. Perform low temperature impact tests in accordance with ASTM D 1998 on condition samples cut from each polyethylene chemical storage tan.

B. Tank Testing

1. Dimensions: Take exterior dimensions with the tank empty, in the vertical position. Outside diameter tolerance, including out-of-roundness, shall be per ASTM D 1998. Fitting placement tolerance shall be +/- 1/2-in vertical and +/- 1 degree radial.

2. Visual: Inspect for foreign inclusions, air bubbles, pimples, crazing, cracking, and delamination.

3. Hydrostatic test: Following fabrication, the bottom tanks, including inlet and outlet fittings, shall be hydraulically tested with water by filling to the top sidewall for a minimum of 1/2 an hour and inspected for leaks. Following successful testing, the tank shall be emptied and cleaned prior to shipment.

PART 3 - EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Shipping shall be per Manufacturer’s Guidelines.

B. All fittings shall be installed and, if necessary, removed for shipping and shipped separately unless otherwise noted by the contractor.

C. Upon arrival at the destination, inspect the tank(s) and accessories for damage in transit. If damage has occurred, Snyder Industries, Inc. shall be notified immediately.

3.2 INSTALLATION

A. Install the tanks in strict accordance with SNYDER INDUSTRIES INC.

B. Installation will be inspected by manufacturer to verify system flexible connections, venting and fittings are properly installed. In addition to on-sight inspection tank system(s) to be reviewed using tank manual check list as supplied by manufacture as listed below.

C. Manufacturer to provide 1 hour training session to prepare operators to service and maintain the tank system. Included in training session will be (2) training manuals.

D. Manufacturer's trained technician to do an onsite inspection of installation. Inspection will verify chemical application, plumbing connections, venting, and applicable ancillary equipment such as ladders, restraints, etc. A verification of proper installation certificate will be supplied when equipment passes installation checklist.

E. Tank manuals will consist of installation check lists, tank drawing(s) as built, fitting drawings referencing nozzle schedule on tank drawing, materials of construction, and recommended maintenance program.

3.3 FIELD HYDROSTATIC TESTING

A. Snyder Industries, Inc. recommends that all tanks be hydro-tested for 24 hours prior to commissioning.

PART 4 - PAYMENT

4.1 All work required for the complete installation and satisfactory installation, including all labor, plant, materials, equipment and specialties; miscellaneous concrete work as required; miscellaneous work; piping , valves and fittings; connections; coordination with other systems and vendors; fittings; painting; testing and start-up; placing in satisfactory operating condition; training and instruction; O & M Manuals; guarantees; and other work as necessary to complete the work herein noted, otherwise called for, shown and/or required, shall be the responsibility of the Contractor.

4.2 Payment shall be made under the lump sum bid in the Proposal of that Contract, unless the work is specifically called for to be provided under another contract.

END OF SECTION 434183

SECTION 462100 – FINE SCREENING EQUIPMENT

PART 1 – GENERAL

1.1 WORK INCLUDED:

A. Supply all labor, materials, equipment and incidentals required to install and place into operation the fine screening system as shown on the Drawings and as specified herein.

1.2 REFERENCE STANDARDS:

A. The properties of all materials, design, fabrication and performance of the equipment to be furnished under this section shall be in accordance with the latest issue of applicable standard specifications. The governing authorities of these standards are listed below.

1. AICS, American Institute of Steel Construction
2. AISI American Iron and Steel Institute
3. ANSI, American National Standards Institute
4. ASCE, American Society of Civil Engineers
5. ASME, American Society of Mechanical Engineers
6. ASTM, American Society of Testing and Materials
7. AWS, American Welding Society
8. IBC, International Building Code
9. IEC, International Electric Code
10. IEEE, Institute of Electrical and Electronics Engineers
11. NEC, National Electrical Code
12. NEMA, National Electrical Manufacturers Association
13. Underwriters Laboratory (UL and cUL)

1.3 SUBMITTALS:

A. Submittals shall be provided to the engineer that includes all the following information:

1. Certified shop drawings showing all important details of construction, dimensions and anchor bolt locations.
2. Descriptive product literature.
3. Schematic electrical wiring diagram and electrical controls information.
4. Complete motor and drive data.
5. The total weight of the equipment.
6. A complete bill of materials of all equipment.
7. A valid certificate of registration naming manufacturer, and supplier if equipment is relabeled, as ISO 9001:2015 certified.
8. A certificate from an industry recognized, independent testing facility verifying compliance with Screening Capture Ratio requirement.

1.4 QUALIFICATIONS:

A. All the equipment specified under this Section shall be supplied by a single manufacturer whose Quality Management System is ISO 9001:2015 certified and applicable to the manufacture of

water and wastewater treatment equipment.

B. Qualified manufacturers shall have a minimum of ten (10) years experience with wastewater screening systems, specifically including Center Flow band screens and washing compactors for consideration.

C. If equipment is not manufactured by supplier, including welding and machining, the name and contact information of manufacturing facility must be supplied. If more than one manufacturer is used all companies and facilities must be provided.

D. If patents protecting equipment are not owned by supplier, then an affidavit must be supplied stating owner of design and expiration of licensing agreement.

E. All equipment specified under this Section shall comply Bipartisan Infrastructure Law's (BIL Public Law 117-58) Build America, Buy America (BABA) requirements for manufactured products. As defined in the Law, this requires

1. The manufactured product was manufactured in the United States, and
2. The cost of the components of the manufactured product that are mined, produced, or manufactured in the United States is greater than 55 percent of the total cost of all components of the manufactured product.

F. Certifications attesting to compliance will be required prior to approval and shall be included with submittals and upon completion of manufacture.

1.5 DESIGN REQUIRMENTS:

A. System Description

1. The fine screen will have a continuous stainless-steel belt that automatically rotates within the internal guide system of the static frame.

2. The fine screen herein specified will be of the center flow type. The flow enters the inside of the continuous belt and exits through both sides and the bottom of the belt.

3. The screen shall have undergone performance testing by an industry recognized, independent testing facility. The results of this testing shall verify a Screening Capture Ratio of at least 84% for solids equal to or larger than the screen grid opening listed in System Performance below.

4. The screen will be installed into the channel as shown on the contract drawings to accommodate the flow pattern through the screen belt.

5. The solids will collect as a mat on the inside of the continuous belt. The belt will intermittently rotate and elevate the solids to the discharge point. Larger objects will be picked up by a series of hooks and/or trays placed at regular intervals.

6. The solids will be removed at the top of the screen by two spray bar headers positioned on the outside of the belt. The screenings will drop into an internal hopper and be fed to the screening handling system.

7. The continuous belt will be directly driven by drive sprockets that shall support and rotate the grid assembly.

8. The screen will be totally enclosed and have access covers that will be lightweight and easily removable for maintenance. Maintenance, inspection, access and lubrication points shall be no higher than 60 inches above grade level.

9. The Washing Compactor will sit under the discharge point of the fine screen.

10. The Washing Compactor will be adequately sized to handle all the screenings and wash water that will be generated by the screen at peak flow. The system will be required to wash the screenings to reduce the organic content and compact the remaining solids into a dry plug.

11. The Washing Compactor will generally comprise of a screw auger rotating within the washing and drainage trough, a wash water system, a compaction zone and an outlet chute arrangement.

12. All stainless steel (including frame, grid and drive components) mentioned below as stainless steel shall be T304 stainless steel. All hardware shall be T316 stainless steel.

B. System Performance – The fine screening system will be designed to meet the following design parameters:

Number of Screens	2
Peak Flow Per Screen	16.5 MGD
Screen Grid Opening	2 mm
Head Loss at Peak Flow	11.86 inches @ 30% blinding and 52 inches downstream water level
Structural Design Differential of Frame/Grid	48 inches minimum @ 100% blinding
Drive Design Differential (Operating)	48 inches minimum
Screen Grid Supporting Drive Sprockets	3 minimum – all stainless steel
Channel Width	48 inches
Channel Height	114 inches
Channel Width – Recess Around Screen	N/A
Number of Washing Compactors	2
Diameter of Screw	6 inches
Diameter of Shaft	2.26 inches
Compactor Discharge Height Above Grade	48 inches
Wash Water Requirements per Screen/WC	82 GPM @ 60 PSI when screen is on

PART 2 - MATERIALS

2.1 MANUFACTURER:

A. The equipment shall be the Center Flow Screen and Washing Compactor as provided by Hydro-Dyne Engineering, Inc., Clearwater, FL. Other than the named supplier, all manufacturers proposing equipment described herein, will provide a detailed submittal package, which will

consist, at a minimum, of all information and details prescribed in Contract Documents.

B. If submitted equipment requires arrangement differing from that specified, prepare, and submit for review complete structural, mechanical, and electrical drawings and equipment lists showing all necessary changes and embodying all special features of equipment proposed. Any changes are at no additional compensation and the Manufacturer will be responsible for all engineering costs of redesign by the Engineer, if necessary.

2.2 CENTER FLOW SCREEN:

A. Perforated Plate - The Continuous Screening Belt

1. The screenings belt will consist of panels manufactured from stainless steel plate that shall be punched with perforations of the specified opening. The stainless steel plate shall be reinforced with a stainless steel frame.

2. The perforated panels will be supported by 12 gauge stainless steel vertical mounted lifting hooks horizontally spaced a maximum of 3 inches apart preventing deflection. The lifting hooks shall support the screening grid and bear tension loads across the entire length and width of the screen belt.

3. The hooks on elements shall form horizontal lifting trays or shelves for removing large solids and rags every 8 inches around the entire screen grid.

4. The perforated panels will be connected by heavy duty stainless steel axles every 8 inches to form a continuous belt that will rotate within the frame's guide system. The axle design will allow the plates to pivot and create a seal between the perforated panels to prevent the passage of solids.

5. The axles will include Delrin spacers that will maintain the 3 inch space between the vertical support elements. Delrin spacers will also form a seal between each perforated panel with clearance not to exceed 0.5mm.

6. The axles will be extended to fix a stainless-steel guide link to the side of each perforated plate. These guides will interlock to create a continuous guide link system that will slide within the frame.

7. Guide links shall be precision machined from solid virgin stainless steel. Injection molded links are not acceptable.

8. The heavy duty guide links will be minimum 2 inches thick to protect against undue wear from grit and will be specially machined to form a closure seal between the rotating belt and the static frame.

9. The seal shall be continuous from grade level through the water flow forming an uninterrupted closure between the traveling screen grid and the stationary frame. The seal shall be heavy gauge stainless steel, fixed to the screen frame and be adjustable so it will remain in contact with the rotating screen belt at all times. There shall be no gap in the grid to frame seal larger than 0.5mm.

10. Guide systems that use rollers, stainless or hardened steel chains will not be acceptable.

11. Grid panel sealing systems that use neoprene seals or stainless steel hinges will not be acceptable.

12. Grid to frame sealing systems that use adjustable stainless steel strips attached to the frame will not be acceptable.

B. FRAME

1. The continuous belt will rotate within a heavy-duty stainless steel static support frame that shall be a rectangular box construction.

2. The guide link system will travel around a stainless-steel guide wear track that is integral to the support frame. Top and bottom wear tracks shall be bolt in and field replaceable.

3. There shall be a removable inspection panel located directly beneath the drive allowing easy access to the grid drive sprockets, drive shaft and screenings collection hopper.

4. The design will ensure that the support frame meshes with the closure seal on each guide link to prevent passage of screening material and grit particles.

5. All components of the lower wear tracks shall be bolt in, field replaceable and manufactured from stainless steel.

6. The frame shall accommodate stainless steel protective covers designed to prevent leakage and contain spray wash. All access covers for maintenance will be lightweight and easily removable. Screens with covers requiring neoprene, rubber or plastic seals are not acceptable.

7. The screen manufacturer will supply the stainless-steel angled filler plates to connect from the upstream corners of the support frame to the channel walls.

8. The back-plate of the screen shall be furnished with a bypass gate that will allow manual removal for complete flow bypass.

C. OFFLOADING OF SCREENINGS

1. Two stainless steel spray wash headers will be located in the head space of the screen to offload the screenings from the continuous belt.

2. The spray bar will incorporate brass nozzles at 2 inch spaces that can easily be replaced or removed for cleaning.

3. The spray bars will be positioned behind the rotating belt and will backwash the solids into an internal hopper manufactured from stainless steel. The wash water will be used to continuously flush the screenings from the internal hopper directly into the Washing Compactor.

4. The addition of a rotating or static brush system to aid offloading will not be acceptable.

D. SCREEN DRIVE MECHANISM

1. Each screen will have a minimum 1.0 hp, continuous duty electric motor suitable for a 460/3/60 supply.As a minimum, the motor will be TEFC with an IP55 enclosure rating and will conform to NEMA MG-1 requirements. The motor will be located outside of the screen covers and above the top of the channel.

2. The gear reducer shall be directly coupled to a heavy duty shaft machined from solid stainless steel round bar.

3. The drive shaft shall be supported on both ends by grease filled roller bearings. Separate grease-filled self-contained cartridge seals shall be mounted on drive shaft between bearings and frame to eliminate spray wash from entering bearings or gear reducer.

4. The continuous belt will be supported and rotated around heavy duty stainless steel sprockets located on the drive shaft in the head space of the screen.

5. These sprockets will have lugs that transmit torque directly from the gear reducer to notches on the underside of the UHMWPE guide links. Driving forces shall be transmitted to areas located behind the screen's grid to prevent solids from contacting drive surfaces.

6. Chain driven systems or screens with wheels submerged in the wastewater are not acceptable.

7. Drive systems that use an external track and pinion to drive or push the band against grid weight supporting wear tracks will not be acceptable. Drive shall lift, and be capable of bearing, the full weight of the grid.

2.3 WASHING COMPACTOR WITH ENHANCED WASHING AND DEWATERING:

A. The main body will be the washing trough that will receive screenings and wash water directly from the discharge point of the screen.

B. The washing trough will house the screw auger and provide a dedicated section to reduce organic content.

C. The stainless-steel drainage section will be slots with 5mm openings and be adjustable to maintain auger alignment. This drainage section shall be removable and easily replaceable in the field with no special tools. The flights of the screw may be fitted with a stiff nylon brush that will maintain contact with the drainage section, preventing blockages. The replaceable brushes will be supplied in pre-coiled lengths with stainless steel removable clamps.

D. The AR400 hardened steel screw auger will sit in the washing trough. Washing compactors with shaftless screws are not acceptable as a shaft is required to support the flight and provide necessary torque and compaction. Screw auger will be primer coated to inhibit corrosion.

E. The auger will be a varied pitch screw aligned at the compaction end by AR400 hardened steel wear and anti-rotation bars designed to prevent the compacted screening from spinning within the compaction zone.

F. The screw will rotate allowing wash water and free organic/fecal material finer than trough

openings to escape and return to the plant flow. The wash water will flush the separated organic material through the drainage section in solution or as small particles.

G. Washing of screenings shall be achieved through an enhanced washing module consisting of the following minimum requirements manufactured out of stainless steel:

1. Variable pitch flight for separate screening transport through the wash, dewatering and compaction zones.

2. Washing Module Zone
   a. Flanged connections and a stainless-steel orifice plate or nozzle
   b. Hardened steel wear and anti-rotation bars
   c. Separately controlled high pressure washing to sheer and break-up organic and fecal material for return to the channel.
   d. Cleansing cycles moving the auger in forward and reverse direction are controlled through the main control panel and operator adjustable up to 9 cycles

3. Dewatering and Compaction Zone
   a. Stainless steel header feeding an external rinse shower
   b. Hardened steel wear and anti-rotation bars
   c. Full circumference perforations for dewatering and extrusion of organics and fecal material.
   d. Attached drainage catch pan with a separate wash water supply to purge the area of accumulated solids
   e. Removable covers for inspection access

H. The compacted screenings will be pushed through the compaction zone and pass through an elbow into an outlet chute. The outlet chute will provide for screening expansion and will elevate the dewatered screenings to discharge by gravity into a waste receptacle (by others).

I. Each Washing Compactor will have a minimum 1.5 hp, inverter duty reversing electric motor suitable for a 460/3/60 supply and rated for a Class 1 Div. 1 environment. As a minimum, the motor will be TEFC with an IP55 enclosure rating and will conform to NEMA MG-1 requirements.

2.4 PARABOLIC PROPORTIONAL WEIR:

A. The manufacturer shall design and supply a stainless steel parabolic proportional weir that will be installed by the contractor downstream of the screen.

B. The weir will be designed to maintain a grid velocity of no more than 3 ft/sec for the full flow range (minimum to maximum).

C. The weir will be designed to maintain a downstream water depth that will increase screen performance during periods of high flow.

D. The weir will be anchored to the sides of the channel with no horizontal supports across the channel to prevent the accumulation of solids.

E. Weir will allow for 2 inch incremental height adjustment and shall have the capability to be safely removed during live flow conditions.

2.5 SPARE PARTS:

A. The manufacturer will supply the following spare parts, per screen supplied, with the equipment:

1. Ten (10) hook links and elements spacers
2. Two (2) grid axles
3. Two (2) guide links

2.6 ACCESSORIES:

A. The manufacturer will supply the following accessories, per screen supplied, with the equipment:

1. One (1) NEMA 7 brass body solenoid valve
2. One (1) wash water strainer
3. Two (2) wash water pressure gauges

2.7 ELECTRICAL CONTROLS AND ANCILLARY COMPONENTS:

A. General Information - The manufacturer will supply one UL listed main control panel and two local control stations that shall automatically control the equipment offered in this section.

B. The Main Control Panel – NEMA 4X stainless steel enclosure for indoor or outdoor installation - panel shall consist of the following components:

1. Allen Bradely PLC for ethernet output for SCADA integration.
2. Main lockout/fused disconnect switch
3. Variable Frequency Drive for screen
4. Compactor motor starter
5. Control transformer, 500 VA minimum
6. Programmable control relay with minimum of 5 cycle timers
7. Fused disconnect
8. Hour run meter
9. Fuses and breakers
10. Motor overload sensor
11. Panel power light
12. Screen run/fault lights
13. Washing Compactor run/fault lights
14. Reset pushbutton
15. Current monitors

C. Ancillary Control Components

1. Float switch
2. Upstream ultrasonic level system consisting of the following per screen:
    a. NEMA 4X enclosure with viewing window
    b. Milltronics Hydro-Ranger 200 controller with real-time 4-20 mA output
    c. One (1) NEMA 4X transducer
3. Local Control Station – NEMA 4X - Each local station panel shall consist of the following components:
    a. 4-hole NEMA 4X cast aluminum enclosure
    b. Hand/Off/Auto switch for each motor

c. Forward/Off/Reverse for compactor
d. Emergency stop

PART 3 - CONSTRUCTION DETAILS

3.1 GENERAL:

A. Applicable stainless-steel materials, including hardware, flanges and piping shall be pickled by means of a four-tank system that is in accordance with ASTMs A380 and A967. This process is for quality control, removal of heat affected discoloration, surface treatment for corrosive environments and to provide a uniform finish to the stainless-steel surfaces. Stainless steel components must be fully submerged in the tanks for complete coverage. Electro-chemical wanding is acceptable on weld finishes that cannot be submerged due to size. Sandblasting, pickling pastes and abrasive cleaners will not be accepted as forms of metal finishing. The drive and grid components do not require pickling.

1. Tank 1 – Detergent bath for the removal of soils, greases, oils and dirt
2. Tank 2 – Rinsing process to remove detergent and residual soils
3. Tank 3 – Two part acid solution for the removal of tightly adhere oxide films
4. Tank 4 – Final rinse process to remove all residual acid

B. All ferrous surfaces (except stainless steel) shall be coated with a pre-primer, primer, and an exterior top coating, or fusion bonded polyester coating suitable for humid/wet environments for superior corrosion protection.

C. Motors and gearboxes shall be surface prepared to withstand humid/wet environments for superior corrosion protection.

3.2 DELIVERY AND STORAGE:

A. The screening system shall be appropriately crated and delivered to protect against damage during shipment.

B. An authorized representative of the Contractor shall inspect the screens on delivery to the jobsite and shall report any damage or missing components to the Manufacturer and the Engineer within 72 hours of receipt of the shipment.

3.3 INSTALLATION:

A. The installation of the equipment shall be as indicated on the drawings and in strict accordance with the Manufacturer’s instructions and recommendations.

3.4 WARRANTY:

A. The Manufacturer of the equipment supplied under this specification shall provide a warranty for a period of twelve months commencing on acceptance and/or beneficial occupancy by the Owner but no later than 90 days from the date of shipment by the Manufacturer. The Manufacturer shall guarantee that the equipment furnished is suitable for the purpose intended

and free from defects in design, materials and workmanship. In the event that the equipment fails to perform as specified the Manufacturer shall, at his option, promptly repair, modify or replace the defective equipment.

3.5 FACTORY TESTING:

A. The screening system and all components shall be factory assembled and tested for a minimum of 24 hours prior to shipment. The equipment shall be shipped fully assembled and shall be capable of being set in place and field erected by the Contractor with minimal field assembly.

B. During the factory test period the screening system shall be adjusted as required assuring proper operation on completion of the field installation. The Manufacturer shall supply a certification of the completion of the factory testing of the assembled screening system and appurtenances and shall certify as to the equipment being in satisfactory operating condition at time of shipment. The Engineer and/or Owner may, at their own option and expense, witness the factory test.

3.6 FIELD TESTS, ADJUSTMENTS, AND COMMISSIONING:

A. The equipment shall be shipped completely factory assembled. Contractor shall verify all access dimensions, channel dimensions, and any interior building dimensions to ensure equipment may be installed as a factory assembled units.

B. After completion of the installation, the equipment shall be inspected and certified by an authorized representative of the Manufacturer as being in compliance with the Manufacturer's recommendations and requirements. At such time as the Manufacturer has deemed the installation to be acceptable, the Manufacturer's authorized service representative shall make any required adjustments and shall start the equipment to assure proper operation.

C. The Manufacturer's authorized representative shall provide instruction to the plant personnel as to the operation and maintenance of the equipment including commissioning, shut down, on-line operations, lubrication and preventative maintenance.

D. Manufacturer shall state field service rates for a Service Engineer to Owner and Contractor. In the event that the field service time required by this section should not be sufficient to properly place the equipment into operation, and the requirement for additional time is beyond the manufacturer's responsibility, additional time shall be purchased by Contractor to correct deficiencies in installation, equipment, or material without additional cost to Owner.

E. The Contractor shall include in his bid, the cost of the above referenced authorized service representative for one (1) trip totaling three (3) eight-hour days total for the fine screens onsite to complete the certifications and training described in this specification section.

END OF SECTION 462100

SECTION 462113 - MECHANICALLY CLEANED BAR SCREEN

PART 1 – GENERAL

1.1 SUMMARY

A. This section includes the furnishing of a front-cleaning, front-return link driven mechanically cleaned bar screen assembly and any auxiliary equipment or accessories to be installed in the location as indicated on the drawings and as specified herein.

Number of units: 1

Equipment designation: Duperon® FlexRake® IQ™, OAE

Equipment location: Indoor Installation

B. All equipment supplied under this section shall be furnished by or through a single screening system supplier who shall coordinate with the Contractor, the design, fabrication, delivery, installation and testing of the screening components. The screening system supplier shall have the sole responsibility for the coordination and performance of all components of the screenings system with the performance and design criteria specified herein.

C. The Contractor shall be responsible to coordinate all details of the screening equipment with other related parts of the work, including verification that all structures, piping, wiring, and equipment components are compatible. The Contractor shall be responsible for all structural and other alterations in the work required to accommodate the equipment differing in dimensions or other characteristics from that contemplated in the Contract Drawings or Specifications.

1.2 RELATED SECTIONS

A. The following list of related sections is provided for the convenience of the Contractor and is for reference only to support commonly referenced sections that are in-general applicable to all equipment supplied (for complete list of sections, see specification index).

1. All sections of Division 1 – General Requirements including but not limited to Submittal Procedures, Product Requirements, Operating and Maintenance Data, Project Record Documents, and Demonstration and Training

2. All applicable sections of Division 26 - Electrical

1.3 REFERENCE STANDARDS

A. American National Standards Institute (ANSI)

B. American Society for Testing and Materials (ASTM)

C. American Welding Society (AWS)

D. American Institute of Steel Construction (AISC)

E. American Bearing Manufacturers Association (ABMA)

F. American Gear Manufacturers Association (AGMA)

G. National Electrical Manufacturers Association (NEMA)

H. Underwriters Laboratory (UL)

1.4 SUBMITTALS

A. The equipment manufacturer shall submit the following items:

1. Six (6) Sets of General Arrangement Drawings that illustrate the layout of the equipment, equipment weight, principal dimensions with related verifications required for installation including anchorage locations. Other related data including descriptive literature, electrical control drawings, catalog cut sheets for individual components and drive motor data.

2. A list of recommended spare parts including any special tools required for routine maintenance of the equipment is provided in Section 2.5.

3. Six (6) Sets of Operation & Maintenance manuals including As-Built Drawings of the mechanically cleaned bar screen arrangement, controls, and accessories shall be provided in digital format after equipment ship for inclusion in the close-out submittal process.

4. For sites that have three (3) feet or greater head differential, equipment manufacturer shall provide structural certification.

1.5 QUALITY ASSURANCE

A. The mechanically cleaned bar screens shall be fully assembled and shop tested at the manufacturing facility prior to shipment. Shop testing shall include a minimum of four (4) hours of run time. The Contractor, the Engineer, the Owner, or the owner's designated representative reserves the right to witness the shop test. Travel expenses are the responsibility of the traveler. A minimum three (3) week notice shall be provided prior to the test to allow for travel coordination.

B. To assure quality and performance: All equipment furnished under this Section and related sections shall be of a single manufacturer who has been regularly engaged in the design and manufacture of the equipment and demonstrates, to the satisfaction of the Engineer. The screen manufacturer shall have at least 50 installations of link driven mechanically cleaned bar screen equipment that has been in successful operation, at similar installations, for at least ten (10) years. Upon request, the manufacturer shall provide a reference of such installation sites along with the relevant contact information.

C. The equipment furnished shall be fabricated, assembled, installed, and placed in proper operation condition in full conformity with approved drawings, specifications, engineering data, and/or recommendations furnished by the equipment manufacturer.

D. No screen manufacturer will be considered by the Engineer as an "or equal" by simply meeting the functional intent of the specifications.

E. The screenings system shall have operations, origin of manufactured, after sales service & support in the United States of America

1.6 WARRANTY

A. Manufacturer shall provide a written one (1) year standard warranty from the date of use of the mechanically cleaned bar screen equipment to guarantee that there shall be no defects in material or workmanship in any item supplied.

B. Manufacturer shall warrant for the period of five (5) years all rotating parts of the mechanically cleaned bar screen including the gear motor, bearing, drive head, and the link system including the links, castings, pins and retaining rings. Manufacturer warrants that these components shall be replaced if damaged or defective in the normal use of the equipment.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. The basis of design for the Screening System shall be as manufactured by Duperon Corporation, 1200 Leon Scott Court, Saginaw, Michigan, toll-free 800.383.8479. The screens shall be the FlexRake® Model, Full Penetration Fine Screens FR IQ™ or approved equal

2.2 BASIS OF DESIGN

A. The mechanically cleaned bar screen shall have a head sprocket only, with no sprockets, bearings, idlers, or similar drive components under water to trap the chain. Equipment featuring reciprocating rake arms or lower bearings/sprockets/tracks below the water is not acceptable.

B. The mechanically cleaned bar screen shall clean the entire bar screen a minimum of every 7.1 seconds at high speed.

C. The flow ability of the screen area, specifically, shall be defined as follows: A composite number representing the specific flow- ability of a screen area composed of the bars' hydraulic head loss coefficient shape factor, the bar width and the clear opening of the screen field per formula below.

$$\text{(Coefficient Shape Factor)} \times \left(\frac{\text{Bar Width}}{\text{(Clear Opening)}}\right) = \left(\frac{0.190}{\text{(Clear Opening)}}\right)$$

D. The mechanically cleaned bar screen shall be designed to run continuously (24/7), without operator.

E. The equipment shall have multiple scrapers on the bar screen at one time cleaning continuously from bottom to top, the entire width of the bar screen. The drive output shaft rotation shall be constant and in one direction in order to reduce maintenance and increase product life. Units which have single raking arms or that require cycle times shall not be allowed. Cleaning mechanisms that utilize shock absorbers, springs or other dampening or hydraulic actuations are unacceptable.

F. The link system shall have jam evasion capability by flexing around and collecting large objects such as a 2 X 4, bowling ball, grease balls and surges of solids at peak loading times without overloading and shutting down the unit. The link system shall be such that it bends in one direction only, which allows it to become its own lower sprocket and frame and shall have a 1,000-pound lifting capacity.

G. Designs employing the use of endless moving media or cables and hydraulic cylinders to remove debris from the channel and units utilizing proximity or limit switches for reverse cycles are not acceptable.

H. Equipment utilizing a motor greater than 1 HP motor to complete a screen cleaning cycle is not acceptable.

I. The design shall be such to ensure that all maintenance can be accomplished at the operating floor level or above. No part of the drive system including sprockets shall be located below the water surface at maximum design flow.

Design Conditions:

Site Installation Information:	
Channel Width:	5.00 ft
Channel Height:	2.75 ft
(upstream clearance) Channel Depth:	See contract drawings
Bar Opening Size:	½ inch
Angle of Installation:	30°
Average Flow:	8 MGD
Average Water Level:	1.4 ft
Maximum Flow:	18 MGD
Maximum Water Level:	1.75 ft
Maximum Head Differential:	9 inches
Equipment Location:	Indoors
Indoor Installation:	
Ceiling Clearance Height:	10’
Site Access Constraints:	None
Roof Opening Available:	None
Door Opening Size:	6’ W x 7’ H
Installation Area Classification:	Class I Div. 1

2.3 COMPONENTS

A. Bar screen assembly: Bar screen assembly shall be of stainless steel and designed to withstand 1 foot head differential unless noted otherwise in Section 2.2 J Design Conditions. Unless noted otherwise materials of construction shall be 304 stainless steel. A stainless steel channel bottom plate shall be an integral part of the bar screen assembly to fully engage scrapers in the bar screen at the base of the unit and assure that the raking mechanism reaches the bottom of the screen to prevent debris accumulation. The bar screen assembly shall be shipped in one piece.

1. Screen Bars: Bars shall be 316L stainless steel and be tear-shaped with a hydraulic coefficient shape factor of 0.76 and the minimum dimensions of 0.25 inch x 0.75 inch x 0.13 inch Bars

shall be individually replaceable without welding. Screen bars shall have a 24 inch diameter curve at the base of the screen to allow for increased flowable area.

2. Side Fabrication: The screen framework shall be 304 stainless steel bent plate with minimum of 3/16 inch cross section. Horizontal members shall be of stainless steel bent plate or stainless steel pipe. Support members and frame shall adequately support the bar screen based on site-specific requirements.

3. Dead Plate: Dead plate shall be 0.25 inch thick 304 stainless steel. The dead plate shall be flat and true; span the entire width of the unit; and transition from bar screen to discharge point.

4. Discharge Chute: The discharge chute shall be 0.25 inch 304 stainless steel. The discharge chute shall be designed to allow debris to be transferred from discharge point into the debris containment.

5. Link Slides: Link slide assembly shall be provided per manufacturer standard design and shall be constructed of UV Stable UHMW PE and 304 stainless steel supports and components.

B. Return Guide/Closeouts: Return guide/closeouts shall be 304 stainless steel and shall assure proper alignment of scrapers as they enter the bar screen and assure that there is no space wider than the clear opening between bars to prevent passage of larger solids than allowed through the screen.

C. Debris Blade: A 304 stainless steel and UV Stable UHMW-PE debris blade assembly, which does not require a separate drive, shall be installed to assist in removing debris from the scraper on the mechanically cleaned bar screen unit as recommended by the manufacturer. Hydraulic, shock, or spring controlled debris blade mechanisms are not acceptable.

D. Screen Enclosure: A 14 gauge #4-brushed satin finish 304 stainless steel enclosure shall be installed to cover the screen above the operating deck level. Front enclosure shall have removable panels for access to equipment. Removable panels shall be 16 gauge 304 stainless steel and shall be provided with a lift off option for "no tool required" access. The top of the front enclosure shall include a knock out for a customer site option to install a 6 inch diameter pipe stub (the option of connecting to the site’s exhaust system, to provide a positive air exchange from interior of enclosure, by others).

E. Link System: The link system shall be passivated stainless steel castings and have a minimum ultimate strength of 60,000 pounds. with a minimum cross section of 1.5 inches and weighing a minimum of 5 pounds each. Parts must meet ASTM A380 specification for surface finish. Link bearing shall be SAE 841 Bronze type for unlimited life. All wear shall happen between the pin and bearing surface.

1. 304 stainless steel system includes 302 stainless steel retaining rings and 304 stainless steel pins.

F. Scrapers: Scrapers shall be spaced 24 inches apart. To provide long product life the scraper shall move at no greater than 34 inches per minute at normal operating speed of .71 rpm allowing for approximately 1.41 debris discharges per minute Thru-Bar™ scrapers: Thru-Bar™ scrapers shall be minimum .25 inch thick x 4.2 inches x screen width 2205 super duplex stainless steel.

G. Drive Head: The drive head shall be located at the top of the mechanically cleaned bar screen.

1. Drive Unit: Each mechanically cleaned bar screen unit shall operate independently and shall have its own drive unit and driven components.

a. 304 stainless steel drive sprockets & 304 stainless steel drive shaft

b. The gearbox shall be shaft-mounted, right angle type and include spiral bevel gearing. The output shaft speed shall be controlled by a vector type inverter or per rake manufacturer's recommendation. It shall have at least a 1.39 or greater service factor based on machine torque requirements. The gearbox shall not be vented to the outside atmosphere. The gearbox shall be grease filled. Oil filled gearboxes are not allowed.

c. The motor shall be AC induction type, inverter duty, mounted to the gear reducer. The motor shall be 1 HP, and rated for Class I, Groups C & D, Class II Groups F & G environments, NEMA design B. Service factor shall be 1.0 or greater, Class F insulation. The motor must be UL listed and designed for continuous operation.

d. The motor shall have built in, normally closed, thermostat to protect from overheating that is to be field wired to corresponding terminal in control panel for redundant (ambient) overload protection.

e. All drive head components shall be of components available in the United States.

2. Bearing: Bearing shall be a non-lubricated no maintenance engineered polymer Thordon® or Vesconite® bearings and shall have a PV value that is less than the limiting PV value of the material. Bearings containing grease are not acceptable.

3. Speed Reducer: Speed reducer shall be a double-reduction, cycloidal style and shall comply with all applicable AGMA standards. The speed reducer shall be capable of a 6/1 speed range with variable output speeds between 0.69 to 4.13 output RPMs (in high flow conditions). The speed reducer shall produce an output torque of 11,000 in.lb. and have a gear ratio of 424:1.

H. Standard Coating: All non-stainless bar screen components shall be coated in strict accordance with the paint manufacturer's specification. Surface preparation shall be done in accordance with SSPC-SP-10 near-white. The three-part coating system shall be manufactured by Tnemec as follows: Prime Coat Series 90-97 Tneme Zinc at 2.5-3.5 mils DFT, Intermediate Coat Series 27 F.C. Typoxy at 3.0-5.0 mils DFT, and Top Coat Series 1095 Endura-Shield at 2.0-3.0 mils DFT. Standard color is 11SF Safety Blue. Material shall meet all state and federal VOC and other regulatory requirements.

I. Alternatives: Any alternate products must provide certified test reports when submitting products other than those specified herein the specification. Test reports shall indicate the test method, system, and requirements for those products being submitted, and shall meet or exceed the test criteria and performance values of the specified coatings herein.

2.4 ELECTRICAL, CONTROLS, INSTRUMENTATION

A. General: Controls for each rake shall be in enclosures provided by the bar screen manufacturer. The bar screen manufacturer shall be responsible for proper sizing and function of the controls at 480V, unless specified otherwise.

1. Main control panels require shading from the sun and shall be operated within a temperature range between 35°F and 104°F.

2. Controls shall be designed to accept incoming power supply per plans/specs and shall include a step-down transformer as needed to achieve 120V.

3. Control Panel(s) shall be constructed to meet the appropriate NEMA classification requirements and will include a main, lockable disconnect. The panel will be constructed by a UL certified control panel build facility and will be supported by the appropriate UL labeling.

4. Controls shall be tested prior to shipment to owner. The rake manufacturer shall verify all overload settings in the rake controller to insure proper overload and speed settings required for the application are properly programmed.

5. Control panel(s) shall be wired complete with a minimum of #16 MTW wire in the appropriate colors for the circuits being supplied. 120VAC control shall be red, grounded AC neutral shall be white, DC control shall be blue, DC neutral shall be white with blue tracer, equipment ground shall be green and all incoming and outgoing external power source wires shall be a yellow configuration. All AC power wiring shall be a minimum of #12 Black. All wires shall be labeled at both ends with heat-shrink wire markers. Internal panel wiring shall be contained in non-flammable, covered wire way.

6. All panel(s) and panel mounted devices shall be labeled with engraved I.D. markers that reference back to the system schematics. Tags shall be white with black core, engraved as required.

7. All field wiring and power cables between the bar screen's Main Control Panel and the Local Control Push Button Station shall be provided by others under the Electrical Section. VFD rated motor cable (Belden #29502 or equal) is recommended for all motors. Motor cables shall be less than 80 feet unless otherwise specified.

B. Components:

1. Main Control Panel

a. Enclosure(s) shall be NEMA 12 painted for indoor installations

b. Enclosure shall not be located in an explosive environment.

c. Main Control Panel shall be designed with a SCCR rating of 18KA at 480VAC minimum and labeled as such, unless otherwise specified.

d. All terminals utilized in the main panel shall be 600V rated terminals and 20% spare terminal space shall be provided for any potential future revisions.

e. The Main Control Panel shall include at a minimum the following

i. Main fusible disconnect with lockable operator, unless otherwise specified.

ii. Physical or virtual Hand/Off/Auto (HOA) Selector and Push/pull E-Stop button.

iii. Elapsed run-time meter

iv. Indication for "Power On", "Forward" and necessary faults.

g. PLC Based Controls shall include the following:

i. Programmable Logic Controller (PLC)

ii. Variable Frequency Drive (VFD)

iii. HMI programmable functions as required

iv. SCADA Interlocking via Hard Contact and/or Ethernet Communications Protocols as required.

2. Local Control Push Button Station

a. Enclosure shall be NEMA 7 rated for Classified area installation. Local push button station must be local to the equipment to maintain requirements of local safety codes as determined by the Engineer.

b. Local station shall be mounted within 10 feet or as close to the equipment as safely possible and be field wired by the electrical subcontractor to the corresponding terminal inputs in the main control panel.

c. The remote pushbutton station shall include Forward, Jog Reverse and E-Stop buttons.

3. Instrumentation: Each raking assembly shall have a separate level system that shall be installed and field wired per the manufacturer's instructions. The HydroRanger® shall be installed in the control panel.

a. Differential Level Control: Shall use a PLC and a HMI. Program shall include multiple differential setpoints used for automatic speed ramping/reducing as the differential level increases/decreases. The uppermost setpoint shall run the rake at high speed. The logic shall also include a "Rake Off" set point which shall be lower than the initial run set point. This set point is required to help avoid intermittent starting/stopping caused by the differential level equalizing with minimal rake run time. Cycle timing logic shall also be included in the program that shall function in parallel with the differential level control logic for optimal rake run time. Level sensing instrumentation shall be installed upstream and downstream from the rake and shall be one of the following types:

i. Siemens HydroRanger® 200 with (2) Ultrasonic Level Transducers. Transducers shall be installed upstream and downstream of the rake, at least 1 foot above the highest anticipated water elevation and the beam angle shall not have obstructions between the transducer face and the water surface. A mechanical float switch can be used in conjunction with the HydroRanger ® as backup control

C. Controls Design Conditions:

Incoming Power: (Voltage/Phase)	460/3
Enclosures:	Separate
Installation location:	Indoors
Approx. distance between main panel and equipment motor	10 feet
Climate controlled location:	Yes
Transducer/Float cable length:	50 feet (standard)

2.5 SPECIALTY TOOLS, SPARE PARTS, AND LUBRICATION

A. Manufacturer shall provide any specialty tools and recommend spare parts required for maintaining the equipment as follows:

1. Snap/Retaining Rings (10)

2. Link Clevis Pins (2)

3. Button Head Cap Screw (4)

4. 3/8”-16 Nylock Nut (4)

5. Snap Ring Tool (1)

6. Anti- Seize paste, 1 oz. tube (1)

PART 3 – EXECUTION

3.1 SHIPMENT

A. Shipment of all equipment shall be coordinated to allow the screen shipment as one complete integrated assembly unless otherwise specified by the Engineer, Owner or Owner’s Representative.

3.2 INSTALLATION

A. Equipment shall be installed in strict conformance with the manufacturer’s installation instructions, as submitted with shop drawings, operation and maintenance manuals and/or any pre-installation checklists. Installation shall utilize standard torque values and be installed secure in position and neat in appearance. Installation shall include any site preparation tasks as required by the engineer or manufacturer; such as unloading, touch-up painting, etc. and any other installation tasks and materials such as wiring, conduit, controls stands as determined by the customer and/or specified by the manufacturer.

B. Anchors: Anchors and nuts shall be 304 stainless steel.

1. Anchors template drawings shall be included in the submittal to permit verification of the location structural elements, new or existing in the concrete.

2. Anchors sizes, quantity, and requirements will be indicated on the submittal drawings. Quantity is site specific but typically each bar screen assembly requires (8) to (12) 1/2" dia. x 4 1/2" Lg. embed HILTI KWIK bolt TZ for mechanical screen anchorage and typically (8) to (12) 3/8" dia. x 3 3/8" Lg. embed HILTI KWIK bolt TZ anchors for the return guide/closeouts anchorage.

3.3 TESTING

A. After completion of installation, CONTRACTOR shall provide for testing performed in strict conformance with the manufacturer's start up instructions. Testing of the bar screen shall demonstrate that the equipment is fully operational by picking up and depositing materials into specified containment.

B. Field certification shall include inspection of the following:

1. Verify equipment is properly aligned and anchored per the installation instructions and drawings. Assure the bar screen unit is square, flat, and unobstructed with required clearances maintained.

2. Assure controls and instrumentation work in all modes.

3. Check equipment for proper operation of debris blade, scrapers, etc. as well as completion of the start-up requirements in the installation guide.

3.4 ONSITE TECHNICAL ASSISTANCE

A. Manufacturer shall provide services to include installation certification, and shall include (1) day for Start-Up and (1) day for Training. Manufacturer shall be given minimum 14 days notification prior to the need for such services. To assure the best outcome for the Owner and Contractor, the Contractor shall provide certification for completion of the PRE-COMMISSIONING CHECKLIST.

END OF SECTION 462113

SECTION 462113.1 – MECHANICAL BAR SCREEN WASHER COMPACTOR

PART 1 – GENERAL

1.1 SUMMARY

A. SCOPE OF WORK

1. Furnish two (2) interleaving, dual auger washer compactor assemblies as shown on the drawings and as specified herein. Unit shall provide washing and compacting action on wastewater screenings. One unit to be installed on new mechanical bar screen, and one unit to be installed on existing mechanical bar screen.

B. RELATED WORK

1. Section 462113 - Mechanically Cleaned Bar Screen

C. QUALITY ASSURANCE

1. All equipment supplied under this section shall be of a single manufacturer and demonstrate, to the satisfaction of the Engineer, that the quality is equal to equipment made by those manufacturers specifically named herein.

2. The equipment furnished shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with approved drawings, specifications, engineering data, and/or recommendations furnished by the equipment manufacturer.

1.2 RELATED SECTIONS

A. The following list of related sections is provided for the convenience of the Contractor and is for reference only to support commonly referenced sections that are in-general applicable to all equipment supplied.

1. All sections of Division 1 – General Requirements including but not limited to Submittal Procedures, Product Requirements, Operating and Maintenance Data, Project Record Documents, and Demonstration and Training

2. All applicable sections of Division 26 - Electrical

1.3 REFERENCE STANDARDS

A. American National Standards Institute (ANSI)

B. American Society for Testing and Materials (ASTM)

C. American Welding Society (AWS)

D. American Institute of Steel Construction (AISC)

E. American Bearing Manufacturers Association (ABMA)

F. American Gear Manufacturers Association (AGMA)

G. National Electrical Manufacturers Association (NEMA)

H. Underwriters Laboratory (UL)

1.4 SUBMITTALS

A. The equipment manufacturer shall submit the following items:

1. (4) Sets of Shop Drawings, including: Main Layout Drawings, List of Equipment Specifications, and Recommendations furnished by the Equipment Manufacturer.

2. (4) Sets As-Built Drawings of Washer Compactor Structure, Controls, and Accessories (as applicable).

3. List of Spare Parts and Special Tools (as applicable).

4. (4) Sets O&M Manuals (including As-Built Drawings) to be provided after equipment ships for inclusion in the close-out Submittal process.

1.5 QUALITY ASSURANCE

A. The Washer Compactor shall be fully assembled and shop tested at the manufacturing facility prior to shipment. Shop testing shall include a minimum of 4 hours of run time.

B. To assure quality and performance: All equipment furnished under this Section and related sections shall be of a single manufacturer who has been regularly engaged in the design and manufacture of the equipment and demonstrates, to the satisfaction of the Engineer, that the quality is equal to equipment made by those manufacturers specifically named herein. And the Washer Compactor manufacturer shall have at least 25 installations of the specified model of Washer Compactor equipment that has been in successful operation, at similar installations, for at least five (5) years. Upon request, the manufacturer shall provide a reference of such installation sites along with the relevant contact information.

Possible consideration may be given to manufacturers with less installation experience but only upon submission and approval of dimensional and installation drawings and O & M Manuals. Additionally, a complete product development plan with dates indicating all applicable alpha and beta testing shall be provided for review and acceptance.

Approval of any manufacturer that does not meet the installation experienced defined herein shall be contingent upon submission and approval of the previously defined information. Additionally, such manufacturers shall be required to provide a performance bond issued in

favor of the owner, covering the full amount of the manufacturer's offering and for the entire warranty period of the project.

C. The equipment furnished shall be fabricated, assembled, installed and placed in proper operation condition in full conformity with approved drawings, specifications, engineering data, and/or recommendations furnished by the equipment manufacturer.

1.6 WARRANTY

A. Manufacturer shall provide a written one year standard warranty from the date of use of the Washer Compactor equipment to guarantee that there shall be no defects in material or workmanship in any item supplied.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Washer Compactors shall be as manufactured by:

1. Duperon Corporation, 1200 Leon Scott Court, Saginaw, Michigan, TF 800.383.8479.

2. Acceptable Equal

B. Or pre-approved equal. Washer Compactor manufacturer seeking pre-approval must submit application a minimum of three (3) weeks prior to bid day. Charges for additional engineering to alter site drawings to meet the intention of the specification shall be at the cost of the manufacturer requesting such change. The necessary submission to be considered a pre-approved equal shall include the following information:

1. Product data sheet

2. Site Specific Proposal Drawing

3. Installation drawings and instructions

4. O & M Manual

5. An employee list of in-house design engineers along with their respective locations and resumes.

6. An employee list of in-house controls engineers along with their respective locations and resumes.

7. An employee list of in-house application engineers along with their respective locations and resumes.

8. An employee list of in-house project managers along with their respective locations and resumes.

9. An employee list of in-house field service technicians along with their respective locations and resumes.

2.2 BASIS OF DESIGN

A. Compacting Action: The Washer Compactor shall have dual augers to provide positive displacement action. Augers shall be oriented on top of each other and rotate in opposing directions. Augers shall be intermeshed, with one left-hand and one right-hand lead. Augers shall be designed with a limited float on top of a strainer to allow for the accommodation of irregular debris.

B. Washing Action: The Washer Compactor shall have a wash water manifold integrated into the main housing. Two ports inside the unit shall emit a medium pressure stream. Wash water shall run continuously when the Washer Compactor is in motion. Continuous operation (non-batching) equipment is required; filling- and batching-type equipment shall not be accepted.

C. Operation: The Washer Compactor shall be continuous run, not requiring an operator. The Washer Compactor shall be equipped with a self-regulating, active pressure zone designed to accept non-standard wastewater debris in its original form, including but not limited to: rocks; broken concrete; and metal (such as bolts or short pipe) up to 4 inches long. The Washer Compactor shall have the ability to process multiple pieces of clothing, variable volumes of debris, and unprocessed septage or grease. The Washer Compactor shall move at a normal operating speed of 0.5 to 2.2 RPM and shall have the ability to run intermittently to sync with upstream equipment.

D. Materials:

1. Fabrications: All welded fabrications shall be made from stainless steel. All welded connections and welding procedures shall comply with AWS “Structural Welding Code – Sheet Steel” D1.3/D1.6.

2. Select Parts: Select power transmission parts to be made from cast iron; however, shall conform to standard coating as follows.

3. Standard Coating:

a. Motor gearbox shall be coated in strict accordance with the paint manufacturer’s specification. Surface preparation shall be done in accordance with SSPC-SP-10 near White. The three-part coating system shall be manufactured by Tnemec as follows: Prime Coat Series 90-97 Tnemec Zinc at 2.5-3.5 mils DFT; Intermediate Coat Series F.C.Typoxy at 3.0-5.0 mils DFT; and Top Coat Series 1095 Endura-Shield at 2.0-3.0 mils DFT. Standard color is 11SF Safety Blue. Material shall meet all State and Federal VOC and other regulatory requirements.

b. Alternatives: Any alternate product must provide certified test reports when submitting products other than those specified herein. Test reports shall indicate the test method, system, and requirements for those products being submitted and shall meet or exceed the test criteria and performance values of the coatings specified herein.

4. Non-Metal: Parts not covered in the specifications above shall be manufactured from UHMW polyethylene.

E. Design Conditions:

Washer Compactor WC3.D3.5 Data Sheet	
Peak Capacity:	30 cu.ft./hr (approx. 15 minutes)
Average Capacity (Continuous):	6.5 cu.ft./hr
Wastewater Application (¼" barscreen):	Up to 15 MGD
Water: Typical	• Utilizes filtered effluent • Consumes 3-10 GPM • Requires 40-60 PSI • ½ inch NPT supply (female threads) • 3 inch NPT drain (male threads)
Materials of Construction:	• 304 SSTL • 17-4 Spur Gears • Delrin (or equivalent) thrust and plane bearings • UHMW Auger Supports
Strainer:	• Perforated Screen
Hopper Height (Deck to Hopper):	38"
Hopper Length (WC3.D3.5 Unit):	67"
Below Freezing Temperatures: Heat tracing on body, transition and discharge chutes (installation and power by others)	No
Performance Data (Typical Wastewater Debris)	
Dry Solids:	30%-60%
Mass/Weight Reduction:	60%-70%
Volume Reduction:	70%-80%
Odor/Fecal:	Significantly decreases odor/fecal
Motor/Drive	
Motor Size:	1 HP
Motor Paint:	Tnemec Coating
Motor Service Factor (Minimum):	1.0
Output Speed:	2.2 RPM
Speed Reducer Ratio/Output:	809:1
Speed Reducer Paint:	Tnemec Coating
Site Power	
Phase/Voltage:	240/480 volt
Controls	
	• NEMA 4X SSTL enclosure • Main Disconnect • Emergency Stop • HOA (Auto is discreet "Run"

	input) • Fwd/Jog Reverse/E-Stop Push Button Station • "Run" and "In Auto" discrete outputs • Explosion-Proof station (local standard)
Mounting:	• Wall • Pedestal (by others)
Project Management	
Submittal Quantity:	2 – 4
O&M Manual Quantity:	2 – 4
Warranty Period:	1 year
Shipping	
	• Main unit • Chute(s)

2.3 COMPONENTS

A. Main Housing: The main housing of the Washer Compactor shall be constructed of stainless steel (material options contained in table) with a minimum thickness of 11 gauge. Support and flange connections shall be 3/8 inch.

B. Hopper: The hopper of the Washer Compactor shall be constructed of stainless steel (material options contained in table) with a minimum thickness of 11 gauge.

C. Augers: The augers shall be of stainless steel (material options contained in table) with 8 inch diameter flights, 3/8 inch thick, with 4 inch flight pitch. The augers shall be coupled to a transmission at the drive end and be supported at the compaction end with UHMW plane bearings. This arrangement shall allow for the accommodation of irregular debris. The auger shaft shall be 2 inch stainless steel schedule 40 pipe with 2 inch solid stainless steel stub shaft.

D. Compaction Housing: The compaction housing of the Washer Compactor shall be ¼ inch stainless steel (material options contained in table) and shall house a spring and gate assembly to provide the resistance for compaction. The compaction housing shall contain the auger supports.

E. Discharge Chute: The discharge chute of the Washer Compactor shall be constructed of stainless steel (material options contained in table) with a minimum thickness of 14 gauge. Support and flange connections shall be 1/4 inch. The discharge chute shall be tapered outward toward the discharge end.

F. Water Supply: The water supply shall connect at a single point with a ½ inch NPT female connector. A NEMA 7/9 Explosion proof solenoid valve is provided to limit the wash water flow to only when the washer compactor is running. Ball valves shall be provided to distribute flow to the washing and trough sprayer connections.

G. Strainer: A strainer shall be located beneath the lower auger to filter the washed solids. The strainer shall be removable via drain trough and pressed against the lower auger with spring

pressure. The strainer shall be self-cleaning through continuous, even contact with the lower auger. Strainers requiring auger-mounted brushes will not be accepted.

H. Drain Trough: A removable pan shall be provided beneath the main housing to collect washwater. Washwater shall be drained through a 3 inch NPT male drain port. The pan shall be a minimum of 11 gauge stainless steel (material options contained in table).

I. Drive Assembly:

1. Each Washer Compactor unit shall operate independently, with its own drive unit and driven components. The gearbox shall not be vented to the outside atmosphere.

2. The gearbox shall be grease lubricated and designed for 5 years (or 20,000 hours of operation) between recommended clean and re-grease services. The gearbox shall be right angle type, and shall incorporate cycloidal and spiral bevel gearing with a total ratio of 809:1. The gear reducer output shaft speed shall be 0.5 RPM minimum to 2.2 RPM maximum and controlled by a vector-type inverter (or greater service factor) based on unit torque requirements. It shall be shaft-mounted utilizing the keyless Taper-Grip® bushing.

3. The motor shall be mounted to the gear reducer by utilizing a quill, C-Face mounting style. The motor shall be AC induction type, 1 HP, 3/60/230/460 volt, explosion-proof, inverter-duty model.

4. The drive assembly shall incorporate the manufacturer's standard coating system.

J. Auger Transmission:

1. The Drive Assembly shall be coupled to a dual gear transmission, which drives the augers in a counter-rotation.

2. The spur gears are contained in a stainless steel housing and supported by Delrin (or equivalent) plane bearing.

3. Grease fittings shall be located outside of the transmission housing to provide lubrication to the gears.

K. Speed Reducer: The Speed Reducer shall have a maximum output of 2.2 RPM, 809:1 reduction ratio with 18,900 in-lb. of output torque.

L. Thrust Bearings: Thrust Bearings shall be Delrin (or equivalent), self-lubricating, and be capable of withstanding a minimum of 2000 lb. of thrust load (each auger) at 2.2 RPM for life of machine.

M. Screw Supports: Screw supports shall be UHWM plane type, self-lubricating, and fastened into place using stainless steel fasteners.

2.4 ELECTRICAL, CONTROLS, INSTRUMENTATION

A. General: Controls the washer compactor shall be in enclosures provided by the washer compactor manufacturer. The washer compactor manufacturer shall be responsible for proper sizing and function of the controls at 480V, unless specified otherwise. Note that the washer

compactor controls can be integrated into the main control panel of the bar screen if provided by the same manufacturer.

1. Main control panels require shading from the sun and shall be operated within a temperature range between 35°F and 104°F. Sunshields, visors or other structures needed to provide shade are by others. (If the controls will experience temperatures outside this range, then special climate provisions are available.)

2. Controls shall be designed to accept incoming power supply per plans/specs and shall include a step-down transformer as needed to achieve 120V.

3. Control Panel(s) shall be constructed to meet the appropriate NEMA classification requirements and will include a main, lockable disconnect. The panel will be constructed by a UL certified control panel build facility and will be supported by the appropriate UL labeling.

4. Controls shall be tested prior to shipment to owner. The washer compactor manufacturer shall verify all overload settings in the motor controller to insure proper overload and speed settings required for the application are properly programmed.

5. Control panel(s) shall be wired complete with a minimum of #16 MTW wire in the appropriate colors for the circuits being supplied. 120VAC control shall be red, grounded AC neutral shall be white, DC control shall be blue, DC neutral shall be blue with a white tracer, equipment ground shall be green and all incoming and outgoing external power source wires shall be a yellow configuration. All AC power wiring shall be a minimum of #12 Black. All wires shall be labeled at both ends with heat-shrink wire markers. Internal panel wiring shall be contained in non-flammable, covered wire way.

6. All panel(s) and panel mounted devices shall be labeled with engraved I.D. markers that reference back to the system schematics. Tags shall be white with black core, engraved as required.

7. All field wiring and power cables between the washer compactor Main Control Panel and the Local Push Button Station shall be provided by others under the Electrical Section. VFD rated motor cable (Belden #29502 or equal) is recommended for all motors. Motor cables shall be less than 80 ft unless otherwise specified.

B. Components:

1. Main Control Panel

i. Enclosure(s) can be NEMA 12 painted for indoor installations.

ii. Enclosure shall not be located in a Classified area.

iii. Main Control Panel shall be designed with a SCCR rating of 18KA at 480VAC minimum and labeled as such, unless otherwise specified.

iv. All terminals utilized in the main panel shall be 600V rated terminals and 20% spare terminal space shall be provided for any potential future revisions.

v. The Main Control Panel shall include at a minimum the following:
- Main fusible disconnect with lockable operator, unless otherwise specified.
- Physical or virtual Hand/Off/Auto (HOA) Selector and Push/pull E-Stop button.
- Elapsed run-time meter
- Indication for "Power On", "Forward" and necessary faults
- Fused connection for the washwater solenoid.

g. PLC Based Controls shall include the following:
- Programmable Logic Controller (PLC)
- Variable Frequency Drive (VFD)
- HMI programmable functions as required
- SCADA Interlocking via Hard Contact and/or Ethernet Communications Protocols as required.

2. Local Control Push Button Station

a. Enclosure shall be NEMA 7/9 rated for Classified area installation. Local push button station must be local to the equipment to maintain requirements of local safety codes as determined by the Engineer.

b. Local station shall be mounted within 10 feet or as close to the equipment as safely possible and be field wired by the electrical subcontractor to the corresponding terminal inputs in the main control panel.

c. The remote pushbutton station shall include Forward, Jog Reverse and E-Stop buttons.

3. Sequence of Operations:

a. The Washer Compactor controls shall enable the push button station installed near the Washer Compactor when in “Hand” mode and utilize an input signal from a remote source when in “Auto” mode. Upon receiving a disruption of “remote source” signal in “Auto” mode, the Washer Compactor shall utilize an off-delay timer to allow debris to finish depositing. The washwater solenoid is energized any time that the washer compactor is running.

b. The Speed Controller fault shall be cleared by turning off the Washer Compactor, then waiting approximately three minutes (or time designated per current UL standards) and then turning the HOA back to the desired setting. A motor overtemp fault shall clear automatically when the motor cools to a temperature within the normal operating range.

4. Miscellaneous:

a. The following shall be provided by the electrical contractor and are not part of the Washer Compactor manufacturer scope of supply:

i. Mounting stands

ii. Mounting hardware

iii. Field wiring and conduit

a. VFD-rated motor cable (Belden #29502 or equal) recommended for all motors.

b. Motor cables shall be less than 80 ft. long unless specified otherwise.

iv. Junction boxes

v. Installation

b. Field wiring shall include (but not be limited to) the following connections as applicable:

i. All incoming power supply to the main control panel.

ii. All required grounding of the motor and controls.

iii. Motor to the main control panel.

iv. VFD-rated motor cable (Belden #29502 or equal) recommended for all motors.

v. Motor cables shall be 80 ft. long unless specified otherwise.

vi. Motor thermostat to the terminal inputs in the control panel.

vii. Washwater solenoid wiring

viii. Input and output signal wiring for remote start/stop as required by plans/specs.

c. Remote station contacts to the corresponding terminal inputs in the main control panel.

2.5 SPECIALTY TOOLS, SPARE PARTS AND LUBRICATION

A. Plane Bearing Kit includes:

1. Side Auger Supports (2)
2. Upper/Lower Auger Supports (2)
3. FHSCS: ¼-20 x 1.00 LG (24)
4. Washer: ¼ Flat SAE (24)
5. Nut: ¼-20 Nylock (24)

6. Grease Tube (14oz.) (1)
7. Anti-Seize Lubricant (1oz.) (1)

B. Casters: A Washer Compactor support frame with casters shall be provided. The frame shall be welded 316 stainless steel construction and shall support the Washer Compactor when fully loaded. Casters shall be stainless steel with composite tread, measuring 6” in diameter and able to swivel 360°. The wheels shall have a locking feature.

PART 3 – EXECUTION

3.1 SHIPMENT

Shipment of all equipment shall be coordinated to allow the Washer Compactor shipment as one complete integrated assembly unless otherwise specified by the customer, contractor, or engineer.

3.2 INSTALLATION

A. Equipment shall be installed in strict conformance with the manufacturer’s installation instructions, as submitted with Shop Drawings, Operation and Maintenance Manuals and/or any pre-installation checklists. Installation shall utilize standard torque values and be installed secure in position and neat in appearance. Installation shall include any site preparation tasks as required by the engineer or manufacturer; such as unloading, touch-up painting, etc. and any other installation tasks and materials such as wiring, conduit, controls stands as determined by the customer and/or specified by the manufacturer. All plumbing shall be completed on site by a qualified individual in accordance with all local and national plumbing regulations.

B. Anchors: Anchors and nuts shall be 304 stainless steel and furnished for each item of equipment by the CONTRACTOR.

1. Anchors template drawings shall be included in the submittal to permit verification of the location structural elements, new or existing in the concrete.

2. Anchors sizes, quantity and requirements will be indicated on the submittal drawings. Quantity is site specific but typically each Washer Compactor assembly requires (4) 1/2" dia. x 4 1/2" Lg. embed HILTI HAS RODS w/ RE-500v3 Adhesive system anchors.

3.3 TESTING

A. After completion of installation, CONTRACTOR shall provide for testing and shall be performed in strict conformance with the manufacturer’s start up instructions. Testing of the Washer Compactor shall demonstrate that the equipment is fully operational and that the equipment will wash, compact, and deposit materials not to exceed 4 inches.

B. Field certification shall include inspection of the following:

1. Verify Washer Compactor is properly leveled and anchored per the installation instructions and site drawings.

2. Assure controls and instrumentation work in all modes.

3. Assure proper auger rotation.

4. Check to assure all Start-Up requirements are completed per the Installation Guide.

3.4 ONSITE TECHNICAL ASSISTANCE

A. Manufacturer shall provide services to include Installation Certification, and shall include (1) day for Start-Up and (1) day for Training. Manufacturer shall be given minimum 14 days notification prior to the need for such services. To assure the best outcome for the Owner and Contractor, the Contractor shall provide certification for completion of the PRE-COMMISSIONING CHECKLIST.

END OF SECTION – 462113.1

SECTION 462323 - VORTEX GRIT REMOVAL EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. This section covers the work necessary to furnish and install, complete, all necessary equipment and appurtenances for the new grit chamber equipment, including paddle apparatus, drive, fluidizer vanes, grit well cover plate, flow control baffles, grit pump, grit concentrator, screw classifier, and controls.

1.2 RELATED SECTIONS

A. Cast-In-Place Concrete – Section 033000

B. Division 26 – Electrical Sections

1.3 REFERENCES

A. Reference Standards: Comply as a minimum with applicable provisions and recommendations of the following:

1. NEC, National Electric Code.
2. NEMA, Standards of National Electrical Manufacturers Association.
3. IEEE, Institute of Electrical and Electronic Engineers.
4. AFBMA, Anti-Friction Bearing Manufacturers Association.
5. ANSI, American National Standards Institute.
6. SSPC, Steel Structures Painting Council.
7. ASTM, American Society for Testing and Materials.

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Section 013300.

B. Submit manufacturer’s qualifications as detailed in 1.5.B.

C. To insure compatibility and complete system integration, all pieces of equipment for the grit removal system (e.g. grit chamber, grit pump, grit classifier,) shall be manufactured by the same company. Components from multiple manufacturers will not be acceptable.

D. Submit locations of the nearest permanent service headquarters.

E. Submit descriptive literature, including a cross-sectional view of each chamber, which indicates materials of construction, weights, principal dimensions and other important details.

F. Submit operation and maintenance data under provisions of Section 017823.

G. Record Drawings: Submit record drawing under provisions of Section 017839.

H. Grit system manufacturer shall provide Computation Fluid Dynamics (CFD) modeling to verify the grit chamber removal characteristics and flow regime. Data on the CFD through generic simulation results of the specified chamber diameter shall be provided with the submittal and prior to approval.

I. Grit system manufacturer shall provide calculations and supporting information to demonstrate sizing of the grit chamber based on particle size, peak flow, and chamber diameter. Units sized on Surface Overflow Rate (SOR) shall not be allowed. Details to be provided with submittal and prior to approval.

1.5 QUALITY ASSURANCE

A. All materials used shall be new, of high grade and of properties best suited to the Work required.

B. Manufacturer's Qualifications:

1. Grit chamber equipment provided under this Section shall submit a list of not less than fifty (50) installations where equipment of the same removal efficiencies as specified herein has been in successful operation for at least five (5) years.

2. Five (5) grit removal efficiency tests shall be provided from an installations where similar equipment by the Manufacturer is currently in similar service. Each grit removal efficiency test shall meet the removal efficiency in 2.3.C. A Manufacturer that does not have test data that is acceptable to the Engineer shall not be considered as an approved equal or be required to provide grit testing of equipment.

C. Coordination Responsibility:

1. To insure compatibility and complete system integration, all pieces of equipment for the grit removal system (e.g. grit chamber, grit pump, grit classifier,) shall be manufactured by the same company. Components from multiple manufacturers will not be acceptable.

2. Contractor shall retain overall responsibility for equipment coordination, installation, testing and operation.

D. Manufacturer shall have operational grit chamber with minimum 4 MGD capacity at their facility and upon request from the engineer, the operational unit may be witnessed by the engineer and/or representative of their choice. Hands on demonstration and training with operational grit chamber shall be completed prior to delivery.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver equipment to and coordinate with contractor.

B. Store and protect equipment prior to installation off the ground in enclosed shelter.

1.7 GUARANTEE

A. Manufacturer shall furnish to the owner a written warranty against workmanship and material for 1 year from the date of substantial completion under normal use and service. Warranty shall be in printed form and previously published as the manufacturers' Standard Warranty for similar units.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish and install the vortex grit removal equipment and appurtenances in accordance with these specifications and as shown on the Drawings.

2.2 MANUFACTURER

A. Smith & Loveless, Inc.

B. Acceptable equal.

2.3 OPERATIONAL CHARACTERISTICS

A. Design each grit chamber for following hydraulic conditions.

1. Minimum Flow: 1.2 MGD.
2. Maximum Flow While Maintaining Below Removal Efficiency: 12 MGD

B. Construct suitable for extremely humid installation, and splash resistant.

C. Limit headloss through grit chamber to 7.5 in. or less at 12.0 MGD.

D. Grit removal from screened raw wastewater.

Grit Size	% Removed (by Weight)
Down to 100-mesh particle size	95

E. Wearing parts readily accessible for inspection, repairs, and replacement.

F. Replacement parts easily duplicated and attainable.

G. No moving parts subject to wear or stoppage below water surface.

H. No bends or elbows on underwater or inaccessible grit piping.

I. Provide drives, lubrication, and support equipment bearings accessible from operating floor level.

J. No loss of grit removal efficiency for flows with inlet velocity less than 3.5 ft/s.

K. Provide inlet ramp to enhance coanda effect and direct grit downward to separation chamber.

L. Grit removal system to fit in grit tank shown on Drawings.

1. Inlet and outlet to be separated by flow control baffle and chamber travel path to be 270°.

2. Storage hopper to have 60° sloped bottom with a maximum diameter of 3’-0” and a minimum depth of 5’-0”.

2.4 GRIT CHAMBER EQUIPMENT

A. Paddles

1. Adjustable grit scouring intensity.
2. Four blades.
3. Material: 316 stainless steel.

B. Propeller Drive Tube:

1. Driven by large, totally enclosed spur gear and turntable bearing.
2. Dia: 10-3/4 in. minimum.
3. Material: 316 stainless steel.

C. Grit Fluidizer

1. Bolted to propeller drive tube.
2. Within 6" of pump suction inlet.
3. Helical configuration.

D. Propeller Drive Unit (Gear Motor and Gear Head):

1. Motor:
   a. Helical gear type.
   b. 1.5hp, 230/460 v, 3-ph, 60 Hz. TEFC
   c. Steel housing and frame.
   d. Service Factor: 2.0 or greater on reducer, 1.15 on motor.

2. Gears:
    a. Alloy steel, heat treated, and hardened.
    b. Teeth: Hobbed and flame hardened.
    c. Helical Gears: Oil lubricated.
    d. Spur Tooth Bull Gear: Large, driven by pinion mounted on output shaft of helical gear motor, enclosed in heavy cast iron case.
    e. Spur Gear Pinion: Cut from heat-treated steel.
    f. Bull Gear: Rotate with minimum 21-in. diameter turntable bearing.
    g. Service Factor for Pinion and Bull Gear: 5 or greater at standard operating speeds.

3. Bull Gear Box:
    a. Specifically designed for this service.
    b. Provide opening for propeller drive table.
    c. Seal with air bell at bottom opening around drive tube.
    d. Provide bolted flanged connection at top for grit pump suction.

4. General Requirements:
    a. Maximum Drive Output Speed: 21 rpm.
    b. Suitable for continuous (24 hrs/day year round) service.
    c. Bearings shall have minimum B-10 bearing life of 50,000 hrs., except 21” diameter turntable bearing which shall have minimum B-10 life of 20 years.

E. Grit well cover plates

1. Maximum 3" opening between cover plate and propeller drive tube.
2. Two-piece with lifting loops.
3. Stationary, not part of rotating assembly.
4. Material: 316 stainless steel.

F. Flow Control Baffle:

1. Integral flow control baffle for the outlet of the main chamber.
2. Material: 316 stainless steel.
3. Fabricate to dimensions as shown on Drawings.
4. It shall be designed to direct the inlet flow into the chamber in a manner ensuring the proper vortex flow and to prevent short-circuiting.

2.5 GRIT PUMP (250 GPM)

A. Pump:

1. Centrifugal, vertical configuration.
2. Close-coupled.
3. Recessed Ni-Hard impeller.
4. Construction: Ni-hard especially designed for use of mechanical seals and vacuum priming.
5. Size: 4” suction, 4” discharge.

6. Capable of passing 4” sphere.
7. Capacity: 250 GPM at 58 ft. TDH.
8. One piece motor adapter/backhead.

B. Motor:

1. 10 HP,1760 RPM, 230/460 Volt, 3 phase, 60 hertz TEFC
2. Minimum 1-7/8" shaft diameter.
3. Solid stainless steel shaft through mechanical seal.
4. 6" maximum lower bearing to impeller distance.
5. Class F insulation, Class B temperature rise, 1.15, unless explosion-proof or VFD duty then 1.0 service factor.

C. Lifting Stanchion
1. A stanchion with lifting arm shall be provided to lift the Grit Pump for disassembly.
2. The lifting arm shall have a hook over the center of the motor to support a hoist provided by the Owner. Installation shall be as detailed in the contract drawings.
3. The lifter shall be designed for a 1,000 lbs. (454 kg) lifting load.

2.6 CENTRIFUGAL GRIT CONCENTRATOR (250 GPM)

A. Mount grit concentrator on grit dewatering screw as recommended by manufacturer.

B. Size, capacity, and range of operation shall be compatible with total grit removal system as described herein.

C. Operates on the constant rate vortex principle.

D. Purpose: Remove water and organics from mixture of grit, water, and organics (pumped by grit pump) prior to grit dewatering screw, thereby minimizing hydraulic load.

E. Flow Pattern:

1. Pumped flow enters tangentially through side.
2. Grit and small volume of water exit out bottom into hopper of dewatering screw.
3. Organic material and rest of water exit out top to drain.
4. Minimum 93% removal of influent water and 95% removal influent organics.
5. Less than 5% putrescible material in recovered grit from underflow.

F. Material: Minimum 1/2" Ni-Hard, high nickel iron coated with minimum 6 mil dry film thickness epoxy resin.

G. No moving parts; operates totally on hydraulic principles.

2.7 GRIT WASHER (for 250 GPM)

A. General:

1. Provide inlet hopper to receive mixture of grit and water, sufficiently large to allow grit to settle out of water.
2. Provide 4” overflow in inlet hopper.
3. Provide unit as freestanding with support legs to hold conveyor at approximately 22° angle from horizontal.
4. Drive screw conveyor with gear motor mounted on discharge end.
5. The PLC control logic will operate the grit washer through its various cycles, including air infusion, grit wash water, spray water, organic drain solenoid valves and ejection cycle, in proper sequence.

A. Construction:

1. Screw:
   a. Diameter: 9 in.
   b. Length: 15 ft.
   c. Material: 316 stainless steel.
   d. Shaftless screws not allowed due to wear or loss of grit.

2. Screw Bearings:
   a. Outlet End: Anti-friction type.
   b. Inlet End: Greaseable bronze bushing.

3. Screw Trough:
   a. Material: 316 stainless steel
   b. Open 3/16” steel formed, U-shaped.
   c. Provide 2” diameter drain at inlet end.
   d. Provide
   e. Provide 8” outlet.
   f. Provide 5'-1/4" of clearance between centerline of support legs and centerline of discharge.

4. Inlet Hopper:
   a. Material: 316 stainless steel.
   b. Overflow: Full-length, double-sided outlet weir trough with 4-in. flange.
   c. Slope three sides of hopper at least 50 degrees to horizontal.
   d. Projected Surface Area: 17.0 sq. ft.
   e. Parallel plates to improve retention of fine grit.

5. Drive:
   a. Provide belt driven shaft mounted helical gear reducer.
   b. Mount on plate bolted to flanges of screw trough at discharge end.

6. Motor:
   a. 3 hp, 230/460 v, 3-ph, 60 Hz. TEFC.

7. Cover:
   a. Material: 316 stainless steel
   b. Solid Covers

c. Opening under concentrator not covered to allow incoming flow to enter unit.

8. Wash Water Requirements:
   a. 20 GPM at 60 psig of plant effluent.
   b. Intermittent.
   c. Water supply may be non-potable, however not wastewater.
   d. If a potable supply is used, a backflow preventer should be provided.

9. Flowmeter:
   a. Wash water shall be controlled by a manual valve and measured by a flowmeter.
   b. Constructed with a tough machined acrylic meter body, highly polished to a clear finish with a direct reading permanent scale.
   c. Float and guide rod shall be constructed of 316 stainless steel.
   d. The flowmeter shall be capable of usage in direct sunlight.

10. Scouring Air Requirements:
    a. 5 SCFH at 70 psig.
    b. Intermittent.
    c. Air shall be provided by NEMA 4X air infusion panel provided by grit system manufacturer.

11. Rotometer:
    a. Scouring air shall be by a manual valve and measured by a rotometer.
    b. Constructed of one piece welded 316 stainless steel with a clear, polycarbonate plastic tube shield and Borosilicate glass tube.
    c. Float shall be constructed of 316 stainless steel
    d. The rotometer shall be capable of usage in direct sunlight.

12. Grit Level Sensor:
    a. A rotating level limit switch with direct contact probe shall send a signal to the controller to begin the grit discharge cycle
    b. This switch shall not be affected by external vibration.
    c. It shall actuate a dedicated DPDT DC relay in the PISTA® TURBO™ Grit Washer control panel.
    d. The electronic enclosure of the switch shall be NEMA 4X.

13. Automatic Spring Loaded Lubricator:
    a. Unit relies on the movement of the bushing to pull grease from the refillable reservoir to the bushing surface.
    b. The reservoir and base shall be constructed of clear polycarbonate, which allows for visual inspection.
    c. The thread size is 1/8” NPT.
    d. Capacity: 6 oz. (178 cc).
    e. Size: 3” (75 mm) diameter x 6” (150 mm) tall.
    f. Operating Temperature Range: -10°F (-23°C) to 250°F (121°C).

2.8 VACUUM PRIMING PANEL

A. Panel

1. NEMA 4X.
2. Mounted on paddle drive unit.

B. Panel Mounted Devices

1. Vacuum Pump:
   a. Corrosion resistant internal components.
   b. Sized to prime pump and piping in less than 60 seconds.

2. Air Compressor:
   a. Oil-less

C. Priming System

1. Consists of vacuum pump, vacuum control solenoid valve, prime level sensing probe, and float operated check valve.

2. Positive lubrication of mechanical seal.

3. Minimum passageway equivalent to 2-1/2" opening.

4. Prime from low-pressure area of pump.

D. Pinch Valve

1. On pump discharge line.
2. In vertical piping.
3. 4" diameter.
4. Pneumatically controlled.

2.9 ELECTRICAL CONTROLS FOR AUTOMATIC OPERATION

A. Panel

1. NEMA 4X.
2. All components within the control panel shall be UL listed or recognized, and the complete grit system control panel itself shall be labeled as a UL 508A General Use Industrial Control Panel.
3. To facilitate wire tracing and servicing, the control wiring shall be run in enclosed wireways, with removable covers, rather than tied up in bundles.
4. Control relays up to 6-amp capacity shall be the modular, plug-in type, with integral LED indicating lights to show activation. Larger control relays shall be enclosed to be “finger safe”.
5. A duplex GFI protected convenience outlet shall be provided in the panel for operation of

120-volt AC devices.

B. Circuit Breakers

1. Thermal magnetic air circuit breakers shall be provided for branch disconnect service and short-circuit protection of all auxiliary circuits
2. Thermal magnetic circuit breakers with lockout capability shall be provided for each drive and pump motor, matched to the motor inrush current.

C. Starters

1. Magnetic across-the-line starters with 24-volt coils and solid-state overload protection for each phase shall be provided for each motor to give positive protection against phase unbalance, thermal overload, phase loss and ground fault.

2. To provide the fastest trip speed and for ground fault protection, only solid-state overload protection will be used, and motor starters using heater coils will not be acceptable.

3. Each single-phase auxiliary motor shall be equipped with an over-current protection device in addition to the branch circuit breaker, or shall be impedance protected.

4. Include for following motors:

   a. Paddle drive.

   b. Grit pump.

   c. Screw conveyor.

5. Individual NEMA 4X Hand-Off-Automatic selector switches shall be provided for the pump and dewatering device drives.

D. Control Devices

1. Spare ethernet port shall be provided

2. Individual NEMA 4X Hand-Off-Automatic selector switches shall be provided for the pump and dewatering device drives.

3. An On Off selector switch shall be provided to operate the propeller drive motor starter.

4. To control the operation of the grit removal and dewatering system, and monitor the control, environmental and alarm functions, a specially preprogrammed, dedicated microprocessor-based control system shall be provided.

5. The PLC shall be an Allen Bradley MicroLogix 1400.

6. The controller shall interface with the panel display unit, motor starters, accessories and alarm functions through digital and analog input and output ports as required.

7. The digital controls shall operate on 24 volts or less, to eliminate shock hazard.

8. The 24-volt DC power supply shall be overload protected to be “crowbar safe” and will return to operation when a short is removed.

9. Program integrity shall be maintained by battery-backed RAM.

10. A surge suppressor with power filter shall be provided for the control circuits.

11. A NEMA 4X rated display unit shall be mounted through the front of the panel to provide operator input to and visual output from the microprocessor controller.

12. This interface shall be a 7” wide screen graphic interface with DSTN 65K-color Liquid Crystal Display with backlighting and resistive-type touch screen, for data input and programming.

13. The display shall have a “sleep” feature to prolong screen life.

14. A minimum of 11 (eleven) menu screens shall be available for display and management of paddle drive, grit pump and grit screw conveyor (optional) functions including, but not limited to:

E. Menu Screens shall be available for display and management of grit system control functions listed below:
   1. Display Functions:
      a. Graphical motor running indication
      b. General alarm indication
      c. Individual alarm indicators for each alarm function (with time and date)
      d. Paddle drive run time
      e. Grit pump run time
      f. Grit screw conveyor run time
      g. Alarm silencing
      h. Date & time indication with set time functionality
      i. I/O status for trouble shooting
      j. Schedule maintenance items
      k. “Help” screens

   2. Field Programming Functions:
      a. Select English or Spanish language display mode
      b. Grit removal schedule or return to default settings
      c. Grit pump run time or return to default settings
      d. Silence audible alarm
      e. Reset running time meters
      f. Set date/time

   3. Grit system control to be integrated with plant SCADA.

2.10 SHOP PAINTING

A. Surface Preparation

1. All structural steel surfaces shot blasted with steel grit.
2. Weld splatter and surface roughness removed by grinding.
3. Comply with SSPC-SP6 specifications.

B. Coating - Grit Mechanism

1. Single, 3 mil DFT primer - shop applied.

C. Coating - Concentrator and Conveyor

1. Single, 6 mil DFT, VERSAPOX® epoxy resin.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation of the grit equipment shall be in complete accordance with the manufacturer's instructions and recommendations, and the reviewed shop drawings.

3.2 TESTING

A. In the presence of the Engineer and the Operator, field testing of all equipment shall be performed to determine that operation is satisfactory and in compliance with the specifications. Testing shall be completed after the installation is complete, the equipment has been operated and all necessary adjustments have been made.

B. Testing shall meet performance criteria listed in Section 1.3 of this specification before final acceptance by engineer and owner.

C. A written report shall be supplied to the engineer upon completion. Repeat tests if necessary, to obtain results acceptable to engineer.

D. The Contractor shall take corrective action to ensure full compliance to meet performance criteria.

END OF SECTION 462323

SECTION 463366 – LIQUID CHEMICAL TRANSFER PUMPS

PART 1 – GENERAL

1.1 WORK INCLUDED:

A. Provide and install liquid chemical transfer pump in accordance with the manufacturer's recommendations, plans and specifications for the application of transferring liquid chemicals Sodium Hydroxide and Sodium Hypochlorite from the bulk storage tank to chemical day tanks.

B. Furnish all material labor, tools and equipment as required shown on the plans and specifications.

1.2 RELATED SECTIONS:

A. Section 402400 for Liquid Chemical Piping specifications.
B. Section 434183 for Liquid Chemical Storage Tanks
C. Section 414010 for Remote Fill Station

1.3 SUBMITTALS

A. Submittal data shall be provided to show compliance with these specifications, plans or other specifications that will influence the proper operation of the pump(s).

B. Standard submittal data for approval must consist of:

1. Pump Performance Curves.
2. Pump Outline Drawing.
3. Station Drawing for Accessories.
4. Electrical Motor Data.
5. Typical Installation Guides.
6. Technical Manuals and Parts List.
7. Printed Warranty.
8. Management system certificate ISO 9001.
9. Manufacturer's Equipment Storage Recommendations.

PART 2 - MATERIALS

2.1 GENERAL

A. The Chemical Transfer Pumps shall be Vanton Flex-I-Liner Size 60, 10GPM, intermittent range 0-50 P.S.I, ½ HP, 1750 RPM, or approved equal.

B. Flex-I-Liner peristaltic type rotary pumps

C. Pump shall be close-coupled or pedestal mounted, sealless and self-priming, with all wetted components of rigid nonmetallic or elastomeric materials.

2.2 PUMP BODY (CASING)

A. Modeled and precision-machined Teflon (PTFE), polypropylene (PP), ultra-high molecular weight polyethylene (UHMW PE) and other nonmetallic materials.

2.3 FLEXIBLE LINER

A. To be precisions molded free standing, field replaceable component made of natural or synthetic elastomeric materials such as Hypalon or Nordel.

B. The contractor shall confirm with the manufacturer regarding the recommended flexible liner material based on the chemicals being transferred.

2.4 SEALESS DESIGN CONFIGURATION

A. Assembly to be free from shaft seals, stuffing boxes, internal valves, glands or gaskets. Pump body and flexible liner to be the only components in contact with the fluid contained in the channel formed by the inner surface of the thermoplastic pump body and outer surface of the liner.

2.5 PUMPING ACTION

A. Fluid movement to be accomplished by a rotor mounted on an eccentric shaft creating a squeegee action within the flexible liner on the fluid trapped between the outer surface of the liner and the inner surface of the pump body. The shaft, rotor and bearings to be completely isolated from the fluid. Pump to be suitable for operating in either direction, in any position, or for dry running. Gentle pumping action to minimize foaming, prevent settling out of suspensions, and permit handling of latex emulsions or other shear-sensitive liquids.

PART 3 - CONSTRUCTION DETAILS

3.1 FACTORY TESTING

A. Each pump is to be tested to assure performance at conditions of service. Test data to be permanently recorded and supplied to the Engineer.

3.2 INSTALLATION

A. All electrical power and control wiring shall be installed by the Electrical Contractor.

B. Install pumps according to the manufacturer's written instructions.

C. Install pumps in locations shown on plans, or location that will allow operators to remove pumps without conflict with other piping.

END OF SECTION 463366

SECTION 464321 - PRIMARY CLARIFIER CONSTRUCTION

PART 1 – GENERAL

1.1 SUMMARY:

A. This section includes the furnishing and installation of equipment for three existing and one proposed 60’ diameter circular spiral scraper cage drive primary clarifiers. The equipment shall include a center drive unit and torque control, walkway and platform with handrail, stationary center influent column, center feedwell, rotating drive cage, rake arms with spiral blades, anchor bolts, scum skimmer, scum box, effluent weir, scum baffle, and all other appurtenances required or shown on the drawings.

B. All equipment supplied under this section shall be furnished by or through a single Supplier who shall coordinate with the Contractor, the design, fabrication, delivery, installation and testing of the clarifier components.

C. The Contractor shall be responsible to coordinate all details of the clarifier equipment with other related parts of the Work, including verification that all structures, piping, wiring, and equipment components are compatible. The Contractor shall be responsible for all structural and other alterations in the Work required to accommodate the equipment differing in dimensions or other characteristics from that contemplated in the Contract Drawings or Specifications.

1.2 SUPPLIER:

A. The clarifier equipment specified in this section shall be WesTech Model COPC2 or approved equal. Substitute equipment must be modified as necessary to provide the specified features and to meet the specified operating conditions.

1.3 REFERENCE STANDARDS:

A. American National Standards Institute (ANSI)

B. American Society for Testing and Materials (ASTM)

C. American Welding Society (AWS)

D. American Institute of Steel Construction (AISC)

E. American Bearing Manufacturers Association (ABMA)

F. American Gear Manufacturers Association (AGMA)

G. National Electrical Manufacturers Association (NEMA)

H. Underwriters Laboratory (UL)

1.4 DESIGN CRITERIA:

A. Influent flow rates per clarifier (MGD w/o recycle)

a. Design (avg. daily flow): 2 MGD

b. Peak (peak hourly flow) with one clarifier out of service: 5.5 MGD

B. Tank diameter (ft): 60 ft

C. Side water depth (ft): 10 ft

D. Freeboard (ft): 1.25 ft (Contractor to field verify)

E. Bottom slope (in./ft.): 1:12

F. Motor HP: 1 hp

G. Torque (ft-lbs)

a. Design running: 14,700 ft-lbs

b. Momentary peak: 29,400 ft-lbs

1.5 SUBMITTALS:

A. Two copies of all materials required to establish compliance with these specifications shall be submitted for review. Submittals shall include at least the following.

a. Certified general arrangement drawings showing all important details and materials of construction, dimensions, loads on supporting structures, and anchor bolt locations.

b. Descriptive literature, bulletins, and/or catalogs of the equipment.

c. Complete data on motors and speed reducers.

d. Wiring diagrams and electrical schematics for all control equipment to be furnished.

e. Calculations documenting the AGMA rating of the drive unit and life of the main bearing prepared and signed by a registered professional engineer.

f. Complete descriptive information and electrical schematic for the torque overload device.

g. Complete sludge transport calculations substantiating the rake blade design, rake tip speed, and floor slope.

h. Complete process calculations substantiating the sizing of the center column and ports, and outer feedwell. These calculations shall be based on parameters from the manufacturer's operating experience. These parameters shall be verified by data presented from successful operating installations. Side by side comparison testing feedwell design from existing operating clarifiers that have spiral rake blades and are products of the manufacturer shall be presented with the calculations.

i. The submittal shall include data from a minimum of five (5) successfully operating installations that verify the experience of the manufacturer. Data shall include performance verification of influent flow rate (Q), hydraulic loading (OFR), effluent suspended solids (ESS), return sludge solids concentration (RSS), return activated sludge flow rate (RAS) for secondary clarifiers, and waste sludge flow rate (WAS).

B. (6) Sets of General Arrangement drawings that illustrate the layout of the equipment, equipment weight, principal dimensions with related verifications required for installation including anchorage locations. Other related data including descriptive literature, Electrical Control Drawings, Catalog Cut Sheets for individual components and Drive Motor Data.

C. A list of recommended Spare Parts including any Special Tools required for routine maintenance of the equipment.

D. (6) Sets of O & M Manuals including As-Built Drawings of the Clarifier Equipment, Controls and Accessories shall be provided in digital format after equipment ship for inclusion in the Close-Out Submittal process.

1.6 QUALITY ASSURANCE:

A. The equipment supplier shall have at least 15 years experience in the design, application, and supply of circular clarifiers in water or wastewater treatment plants, and shall submit a list of not less than 25 operating installations of clarifiers with spiral rake blades as evidence of meeting the experience requirement. This experience shall be evidenced by process performance data that is submitted showing actual data on a minimum of five existing installations that are operating successfully as required in the submittal section.

B. To show evidence of being able to provide the quality of equipment and services described in this specification, the equipment supplier shall submit their ANAB-accredited ISO 9001 quality system certification. AIAO-BAR accredited systems are not a recognized equivalent and are therefore specifically prohibited. The quality procedures shall provide for a means of qualifying all sub-vendors and shall specify that the fabrication facility is a critical vendor and shall require inspection. The quality system shall be audited on-site by a third-party independent registrar at least annually. Certification shall remain in effect throughout the project start-up. Mechanism shall be manufactured according to requirements of Machinery Directive 98/37/EC.

C. The equipment specified herein shall be factory assembled as far as practical to verify that all mating parts can be field assembled. All mating parts shall be trial fit and match marked. The

manufacturer shall submit certification of shop trial assembly and photographs of assembly before shipment. The customer and installing contractor shall be given the opportunity to witness the shop assembly.

D. Shop inspection shall be performed by a qualified inspector and certified by the manufacturer. The inspection shall be documented and all deficiencies noted, corrected, re-inspected and final completion formally authorized. Final shipment authorization shall be by the manufacturer to ensure completion of all fabrication, assembly, and inspection requirements. Inspection records and evidence of inspector qualification shall be submitted to the owner upon request.

E. To assure quality and performance: All equipment furnished under this Section and related sections shall be of a single manufacturer who has been regularly engaged in the design and manufacture of the equipment and demonstrates, to the satisfaction of the Engineer, that the quality is equal to equipment made by those manufacturers specifically named herein. The equipment furnished shall be fabricated, assembled, installed and placed in proper operation condition in full conformity with approved drawings, specifications, engineering data, and/or recommendations furnished by the equipment manufacturer.

1.7 WARRANTY:

A. A written supplier's warranty shall be provided for the equipment specified in this section. The warranty shall be for a minimum period of five (5) years from start-up. Such warranty shall cover all defects or failures of materials or workmanship which occur as the result of normal operation and service except for normal wear parts (i.e. squeegees, skimmer wipers, etc.).

PART 2 – MATERIALS

2.1 GENERAL:

A. Description

a. The clarifier mechanism shall be of the center drive type, supported on a stationary influent column, with the flow entering at the bottom of the influent column and flowing upward into the energy dissipating inlet. The flow shall then proceed into the feedwell through gates arranged for impinged flow near the water level for further energy dissipation and settling. The clarifier shall be designed to remove settled sludge from the bottom of the tank and floating scum from around the periphery of the tank.

i. The clarifier shall perform the following integrated functions:

1. Dissipate energy and control localized currents.

2. Separate solids form the clear liquid.
3. Evenly withdraw the clear liquid.
4. Transport and thicken settled sludge.
5. Remove scum from the clarifier surface.

B. Materials

a. All structural steel shall conform to AISC – Steel Construction Manual latest edition. All steel plates shall conform to ASTM A36. All structural steel shape series of M, MT, S, ST, C, MC, L shall conform to ASTM A36. Structural steel shapes W, WT, HP shall conform to ASTM A992/A572. All pipe shall be ASTM A53, Grade B. All square and rectangular tubing shall be ASTM A500, Grade B, unless otherwise noted. Steel members in contact with liquids, either continuously or intermittently, shall have a minimum thickness of 1/4 inch unless otherwise noted. All aluminum shall be type 5052, 6061, 6063, or 2014 alloy unless noted. All stainless steel shall be type 304/304L unless noted.

C. Fabrication

a. Shop fabrication and welding of structural members shall be in accordance with the latest edition of the "Structural Welding Code", AWS D1.1, (AWS D1.2-Aluminum, AWS D1.6-Stainless Steel), of the American Welding Society. All welded connections shall develop the full strength of the connected elements and all joined or lapped surfaces shall be completely seal welded with a minimum 3/16" fillet weld. Intermittent welding shall not be allowed, except on non-ferrous metals.

D. Edge Grinding

a. Sharp projections of cut or sheared edges of ferrous metals shall be ground to a radius by multiple passes of a power grinder as required to ensure satisfactory coating adhesion.

E. Shop Surface Preparation and Coating

a. All equipment supplied by the Manufacturer shall be surface prepped and coated in the factory with the products as shown in the following table or acceptable equal:

TABLE 1 - SURFACE PREPARATION AND COATING

COATING AREA	SURFACE PREPARATION	COATING
Submerged	SSPC-SP10 Blast	One (1) coat Tnemec N140-1255 Epoxy, 4-6 mils DFT, and one (1) coat Tnemec 140-B5712 Epoxy, 4-6 mils DFT
Non-Submerged	SSPC-SP6	One (1) coat Tnemec N140-1255 Epoxy, 4-6 mils DFT, and one (1) coat Tnemec 140-Color B5712 Epoxy, 4-6 mils DFT
Drive Unit	SSPC-SP6	One (1) coat Tnemec N140F-1255 Epoxy, 3-9 mils DFT, and one (1) coat Tnemec 1074U-B5712 Polyurethane, 2-5 mils

		DFT

F. Structural Design

a. All steel design shall be in accordance with the AISC Manual of Steel Construction, latest edition and the International Building Code (IBC), latest edition.

2.2 DRIVE MECHANISM:

A. Design Parameters

a. The drive unit shall be designed and manufactured by the clarifier equipment supplier to ensure unit responsibility. The drive unit shall be designed for the torque values previously listed. It shall turn the mechanism at the design collector tip speed. The drive main bearing shall be designed for the total rotating mechanism loads with a minimum L 10 life of 50 years or 438,000 hours. The drive unit shall be capable of producing and withstanding the previously listed momentary peak torque while starting. The drive main gear shall be designed to a minimum AGMA 6 rating when rated in accordance with the latest AGMA standard. Gear teeth shall be designed for proper load distribution and sharing. Stub tooth design and surface hardening of the main gear shall not be allowed. The main bearing shall be capable of withstanding the listed overturning moment without the aid of any underwater guides or bearings to ensure correct tooth contact for AGMA rating of the main gear.

i. All spur gearing shall be designed to the latest AGMA spur gear standard for strength and surface durability, based on a life of 175,000 hours. The design running torque rating of the drive gearing shall be based on the smaller of the strength and durability values determined from the above AGMA standard. To ensure safety and ease of maintenance, all components of the drive shall be direct coupled.

ii. No overhung pinions shall be allowed on the speed reducing unit. The lower pinion bearing shall not be located below the turntable base.

iii. Any and all welding on the drive unit shall be done using E70XX weld rod.

B. Physical Characteristics

a. The drive unit shall consist of a solid internal main spur gear, bearing turntable, pinion, secondary speed reducer, support base, and drive unit bearing. The drive shall be mounted on the center column and support the entire rotating load of the mechanism. The main internal gear shall be forged of alloy hardened steel. The pinion shall be heat treated alloy steel. All speed reducers shall be fully enclosed and running in grease. Support base for the drive shall be of welded steel to assure rigidity. Lubricant and dust shields shall be

provided. The drive bearing shall include a forged steel precision gear/bearing set, with fully contoured raceways hardened to a minimum 58 60 Rc and protected by a neoprene seal. Strip liners designed for periodic maintenance and replacement shall not be acceptable. The drive shall be designed so that the balls and nylon spacers can be replaced without removing the access walkway. The main gear to pinion gear mesh shall be oil lubricated. Lubrication fittings shall be readily accessible. Continuous condensate drains shall be provided in the main gear housing.

C. Overload Protection

a. An overload device shall be provided in a stainless steel, NEMA4x enclosure. The device shall be actuated by torque generated from the main drive, which shall operate two independently adjustable switches (the alarm switch at 100 percent of design running torque and the motor cutout switch at 120 percent of design running torque). Devices that require the worm to float and measure the thrust of the worm gear shall not be acceptable. These two switches shall be factory adjusted to accurately calibrate the alarm torque value and the overload position. A visual torque indicator shall be provided and oriented so that it may be read from the walkway. It shall be calibrated from 0 to 160 percent of design running torque.

D. Turntable

a. The turntable base shall have an annular bearing raceway upon which the rotating assembly rests. It shall have a maximum allowable deflection in accordance with the bearing specifications. The allowable modulus of elasticity shall be a minimum of 29 x 106 psi. The center cage shall be fastened to and supported from the gear casing. Ball bearings shall be of high carbon chrome alloy 52100 steel running in fully contoured races, as part of a precision gear/bearing set. The balls shall be oil lubricated and protected by elastomer seals. Felt seals that allow the entrance of moisture from outside the drive (i.e. rain water, condensate, etc.) will not be allowed.

E. Speed Reducing Unit

a. The speed reducing unit shall consist of cycloidal, helical, or planetary speed reducers directly connected to a motor without the use of chains or v belts, and shall be keyed to the pinion.

b. The main ring gear of cycloidal drives shall be made of high carbon chromium bearing steel and be fixed to the drive casing. An eccentric bearing on the high speed shaft shall roll cycloidal discs of the same material around the internal circumference of this main ring gear. The lobes of the cycloid disc shall engage successively with pins in the fixed ring gear. The movement of the cycloid discs shall be transmitted then by pins to the low speed shaft. Speed reducer efficiency shall be a minimum of 90% per reduction stage.

i. Speed reducer helical or planetary gearing shall be manufactured to AGMA standards and shall provide at least 95% power transmission efficiency per stage.

The speed reducer shall have a minimum service factor of 1.25 based on the output torque rating of the drive.

ii. The reducers shall be fitted with radial and thrust bearings of proper size for all mechanism loads and be grease lubricated. As a safety feature, the speed reducer shall be back drivable to release any stored energy as the result of an over torque condition.

F. Motor

a. The motor shall be a squirrel cage, induction type, TEFC, ball bearing heavy duty unit of ample power for starting and operating the mechanism without overload, with a minimum service factor of 1.15.

i. Power supply to the equipment shall be 240/480 volt, 60 hertz, 3 phase.

2.2 WALKWAY AND PLATFORM

A. Walkway

a. One (1) 36 inch wide walkway and platform with handrails shall be supported by the drive unit and influent column at the center and the tank wall at its outer end, and shall be designed to safely withstand a live load of 50 pounds per square foot. Deflection shall not exceed L/360 when both the dead load and live loads are applied. It shall consist of two trusses or beams with 1 1/4 inch aluminum I-bar grating between the trusses or beams. The walkway shall be diagonally braced against lateral movement, and provided with handrails 42 inches high, of double row 1 1/2 inch diameter horizontal aluminum pipe, and 4 inch high kickplates on both sides. Walkway trusses may serve as the handrail if the top chord is 3 feet-6 inches above the walking surface.

i. Stainless steel bearing plates, UHMW-PE slide plates, and anchor bolts for the wall support shall be provided by the equipment supplier and installed by the contractor. Bearing plate dimensions and anchor bolt diameter, length, quantity, and arrangement shall be per the equipment supplier. The contractor shall block out or otherwise modify the tank or support structure to accommodate walkway and supports, if required.

B. Center Drive Platform

a. A center drive platform shall be provided which allows 24 inches clearance outside the center drive components. It shall consist of 1/4 inch aluminum checkered plate with necessary stiffeners and supports, resting on the drive unit and center column, and provided with connections to the walkway. The entire platform shall be surrounded by

handrails 42 inches high of double row 1 1/2 inch diameter horizontal aluminum pipe with 4 inch high kickplates.

2.3 INFLUENT AND SLUDGE REMOVAL

A. Stationary Center Influent Column

a. A stationary cylindrical steel influent column of 1/4" minimum wall thickness shall be provided. One end shall have a support flange for bolting to the tank floor over the influent line, with a similar flange at the top for supporting the drive unit and walkway. The structure and anchor bolts shall provide adequate support for the entire mechanism dead load plus live loads and torque with an adequate factor of safety to eliminate excessive deflection or vibration. Suitable openings shall be provided in the upper portion of the column to allow unrestricted passage of the flow into the energy dissipating inlet.

i. Prior to the center column being grouted in place, the drive unit shall be installed, positioned, and leveled.

B. Feedwell

a. The flocculating feedwell shall be located outside of the drive cage to diffuse the liquid into the tank without disturbance or formation of velocity currents. Baffled openings shall be provided near the water surface to allow scum to exit the feedwell.

i. The supports for the feedwell shall be located either above the liquid extending from the cage or bridge, or on the rake arms. Submerged supports from the rake arms shall be designed so as to minimize horizontal flow disruption.

ii. The depth of the feedwell shall be such as to provide proper detention time and an exit velocity at maximum flow that will not scour the settled sludge. The diameter, depth, detention time, and exit velocities shall match the process application calculations as evidenced by the required successful operating installations.

iii. The feedwell shall be made of not less than 3/16 inch thick steel plate with necessary stiffening angles.

C. Center Cage

a. The center cage shall be of steel box truss construction. It shall be provided with connections for the two sludge rake arms and feedwell supports if required. The cage top shall be bolted to the main gear which shall rotate the cage with the attached arms and feedwell. The cage and each arm shall be designed to withstand 150 percent of the design running torque of the drive without over stressing the members. Loading to develop the torque shall be considered as uniform loads applied to each arm individually.

D. Sludge Rake Arms

a. The mechanism shall include two long sludge rake arms of steel truss construction with spiral shaped steel scraper blades and adjustable stainless steel squeegees. Squeegees shall be fastened to the rake blades with stainless steel fasteners.

i. Scraper blades shall be designed for sufficient sludge transport capacity to handle the design solids loading rate, with the depth of the blade varying from a minimum at the tank periphery to a maximum at the tank center.

ii. Blades shall properly convey settled sludge to the sludge withdrawal point. Blades which move sludge away from the center column to the withdrawal point ring shall also be provided.

iii. The arms shall be adjustable at the cage to assure an even grout thickness over the tank bottom.

iv. The rake speed shall be sufficient to transport the necessary volume of sludge to the sludge outlet, but shall not re-suspend settled sludge.

2.4 SCUM REMOVAL

A. General

a. The clarifier manufacturer shall furnish two (2) skimming devices as part of each clarifier mechanism. Each skimming mechanism shall be arranged to sweep the surface of the sedimentation compartment, automatically removing scum and floating material to a scum box at the periphery of the tank.

B. Skimmer Construction

a. The rotating scum skimmer shall include a horizontal steel plate skimmer blade supported by vertical steel members extending up from the rake arms. The blade shall extend from a point 6 inches away from the influent feedwell to the hinged scum skimmer assembly at the tank periphery.

C. Scum Skimmer Assembly

a. A hinged scum skimmer assembly shall be mounted on the outer end of the skimmer blade. The hinged scum skimmer assembly shall be designed to form a pocket for trapping the scum. The hinged arrangement shall insure continual contact and proper alignment between wiper blade, scum baffle, and ramp as the blade travels up the scum box ramp. The wiper blade shall have a wearing strip on its outer end which contacts the scum baffle and a neoprene strip on its lower and inner edge. The neoprene wipers shall

be a minimum 1/4 inch thickness. The scum is trapped as the wiper blade meets the ramp and is raised up the ramp to be deposited into the scum trough for disposal.

D. Scum Box

a. The scum box shall be of the size specified, supported from the tank wall and connected to the scum withdrawal piping. It shall be made of ¼ inch thick welded steel plate. The box shall have a scum trough, vertical steel sides, and a sloping approach ramp that extends from 1-1/2 inches above water level to 5-1/2 inches below. A similar ramp shall be provided at the opposite end to allow the skimmer blade to lower back to the operating position. A flexible connector shall be provided for connection to the contractor supplied scum withdrawal piping in the tank wall.

E. Scum Flushing Valve

a. A valve shall be attached to the scum box which automatically opens and allows clarified liquid into the scum box to flush out solids. The valve shall actuate at every pass of the scum skimmer over the scum box, allowing sufficient delay after deposit of the solids before flushing begins. Delay and flush duration shall be adjustable. The opening and closing of the scum flushing valve shall be one smooth continuous movement. The valve shall provide 2 to 5 gallons of flush water per each pass of the skimmer assembly.

F. Scum Baffle

a. The baffle shall consist of 1/4 inch thick x 12 inches deep fiberglass sections. In the area of the scum box the scum baffle shall extend to 24 inches starting approximately 6 feet before and ending 2 feet after the scum box. The baffle sections shall be curved and fastened to the launder wall with adjustable FRP support brackets, stainless steel fasteners, and anchor bolts.

2.5 EFFLUENT REMOVAL

A. Weir

a. An adjustable weir shall be provided around the periphery of the tank at the water surface for removal of clarified effluent.

i. The weir shall consist of 1/4 inch thick x 9 inches deep fiberglass sections with 2-1/8 inch deep 90 degree v notches at 8 inch intervals. The weir sections shall be curved and fastened to the launder wall with special large washers, anchor bolts, and hex nuts to allow vertical adjustment

2.6 ELECTRICAL

A. The equipment supplier shall furnish all electrical items specifically called for in this specification section. The contractor shall supply and install all other electrical items required to place the equipment into service.

B. The contractor shall supply and install all field wiring required including but not limited to proper size wire, conduit, fittings, and supports.

2.7 CLARIFER CONTROL PANEL

A. The Clarifier manufacturer shall provide a NEMA 4X, 304 stainless steel control panel to control and protect the Clarifier mechanism. The control panel shall be wired to accept a 480 volt power feed, a control power transformer shall be provided to power all internal controls. The control panel shall be built in a UL508A/698 certified panel shop.

B. The control panel shall be provided with the following devices mounted on the exterior of the enclosure.

   a. Top mounted amber strobing alarm light, Federal Signal LP3P.

   b. Top mounted alarm horn, Federal Signal 350B.

   c. Door mounted rotary disconnect handle, Square D Type L.

   d. Door mounted red running light, Idec series TWTD.

   e. Door mounted amber torque cutout light, Idec series TWTD.

   f. Door mounted off/on 2 position selector switch, Idec series TWTD.

   g. Door mounted alarm silence pushbutton, Idec series TWTD.

   h. Door mounted reset pushbutton, Idec series TWTD.

C. The control panel shall be provided with the following devices mounted on the interior of the enclosure.

   a. 15 amp molded case main breaker, Square D series HDL.

   b. 250 VA control power transformer, Acme series AE06.

   c. NEMA size 00 FVNR motor starter, ABB series AF.

   d. Control relays, Idec series RH.

   e. Terminal blocks, Phoenix Contact series UT4

D. The following signals shall be made available as dry contacts for remote monitoring by the plant SCADA

   a. Rake drive running

   b. Rake drive motor overload

   c. High torque alarm

   d. Cutout torque alarm

E. Workmanship shall be of the highest quality with all wiring on the enclosure back panel routed through plastic wire way and all door routed wire securely fastened with adhesive feet and nylon ty-wraps. Wires that cross enclosure hinges shall be protected with nylon spiral wrap and must have adequate slack to allow the door to open 180 degrees. All components on the back panel shall be mounted using #14 machine screws. Rivets and self-tapping screws are not acceptable.

F. The control panel shall be mounted by the electrical contractor on the platform handrail adjacent to the Clarifier drive unit. All conduit and wiring between the Clarifier control panel, drive torque monitor, power distribution system and the SCADA system shall be provided and installed by the electrical contractor.

2.8 ANCHORAGE AND FASTENERS

A. Anchor Bolts

   a. All anchor bolts shall be a minimum of 1/2 inch diameter and made of type 304 stainless steel. The equipment supplier shall furnish all anchor bolts, nuts, and washers required for the equipment.

B. Fasteners

   a. All structural fasteners shall be a minimum of 1/2 inch diameter and made of type 304 stainless steel. The equipment supplier shall furnish all fasteners required for the assembly of the equipment.

PART 3 - EXECUTION

3.1 GENERAL

A. The equipment shall be installed properly to provide a complete working system. Installation shall follow the supplier’s recommendations.

3.2 MANUALS

A. The equipment supplier shall furnish an electronic copy of the operation and maintenance manual, which will be retained at the installation site to assist plant operators. The manual shall include the supplier's erection and assembly recommendations and a complete list of recommended spare parts.

3.3 FIELD SERVICE:

A. The equipment supplier shall provide the service of a qualified representative for one trip and one day per mechanism to inspect the mechanism installation, assist in start up, and instruct plant personnel in the proper operation and maintenance of the mechanism.

3.4 FIELD TESTING:

A. Torque Tests

a. The entire sludge collector mechanism shall be statically load tested by loading the rake arm with 150 percent of the specified design running torque. The test shall verify the torque overload control device settings for alarm and motor cutout. One truss arm shall be anchored and the load measured to demonstrate the rake arms', cage's, and drive unit's ability to withstand the specified torque. Sketches and calculations shall be submitted illustrating how the torque will be applied prior to the test taking place.

B. Operation Tests

a. The contractor shall operate the mechanism in a dry tank for a minimum of 4 continuous hours before flow is allowed to enter the system. There shall be no binding, jerky, or unusual motion exhibited during this run in period. Motor amperage shall be checked at least hourly for any unusual or higher than normal figures. After the unit has successfully passed this initial test, flow shall be introduced into the tank and the same 4 hour observation test run. If the unit should fail under any of these conditions, the test shall be halted and the problem corrected. If, after several attempts, the unit does not successfully pass the field test, the faulty portion of the equipment shall be repaired or replaced and the test re-run.

END OF SECTION 464321

SECTION 465136.22 AERATION DIFFUSER SYSTEM

PART 1 – GENERAL

1.1 SUMMARY:

A. The work shall include the complete installation of all components of all aeration fine bubble diffuser systems in the sludge holding and post aeration units. The equipment/components shall include, but not necessarily be limited to, the following:

1. Drop pipe, manifold and distribution headers;
2. Fine bubble diffuser and accessories;
3. Manifold and distribution header support system;
4. 304 stainless steel bolts, nuts, thread sealant, and gaskets for flanged joints as required in the Contract Documents;
5. Miscellaneous piping, valves, fittings.

B. All mechanisms and parts shall be amply sized and proportioned for the stresses which may occur during fabrication, erection, operation and periods of non-operation for maintenance, repair or other reasons.

1.2 EXISTING CONDITIONS:

A. It shall be the Contractor's responsibility to investigate all existing site and equipment conditions that may affect the work, prior to placing the bid.

B. The Contractor shall take all necessary as-built measurements and make all necessary investigations in the field, prior to layout of the proposed installation.

1.3 RELATED SECTIONS:

A. Positive Displacement Rotary Lobe Blower Package – Section 431133

1.4 SUBMITTALS REQUIRED:

A. The Contractor shall not deliver nor place any materials, until such time that each material used in the work has been submitted and accepted by the Engineer.

B. Shop Drawings shall indicate the size, construction, assembly, materials of manufacture, manufacturer and Model No., and all other pertinent information to indicate compliance with this Specification and as required, such that the system can be determined acceptable by the Engineer.

C. The Contractor shall furnish dimensioned layout and erection drawings showing proposed installation of all parts of the system, as coordinated with all associated structural work, equipment installations, etc., whether included in his Contract or by others.

D. Three (3) complete sets of Shop Drawings shall be submitted to the Engineer. The Shop

Drawings shall bear the Contractor's stamp of approval indicating that he has reviewed the contents, and that same complies with the Contract requirements.

E. Shop Drawing submittals shall conform to the requirements of Division 01 of the General Requirements.

1.5 QUALITY ASSURANCE

A. Shop Drawings shall be provided to demonstrate compliance with the material, construction and performance requirement. If any manufacturer desires review as an "or equal", or in any way takes exception to, or requests a waiver of certain aspects of this Specification, any and all additional information requested by the Engineer or Owner shall be submitted, such that the acceptability of the "or equal" can be determined.

B. If the standard product of the manufacturer does not comply with the requirements noted herein this section, the manufacturer shall make any and all necessary modifications to the equipment supplied, such that the standards are met. All such modifications shall be made fully at the Contractor's expense, and are subject to the acceptance of the Owner and Engineer.

1.6 EXPERIENCE REQUIREMENTS

A. No equipment shall be supplied by any manufacturer not regularly engaged in the manufacturing and production of municipal aeration equipment of the size and character specified in the Contract Documents. The manufacturer shall have a minimum of five (5) years experience in the manufacture of fine bubble diffusion systems.

B. The Owner reserves the right to review the manufacturer's experience in the manufacturing and installation of similar equipment in its review of the Shop Drawings for acceptance. This review will include a requirement to submit operating and performance data for the equipment proposed to demonstrate that the equipment proposed is capable of providing the treatment required at the project site. Failure to submit such data shall be considered sufficient grounds for the Owner to reject the proposed equipment.

PART 2 – MATERIALS

2.1 STAINLESS STEEL MATERIALS AND FABRICATION

A. Fabricate all welded parts and assemblies from sheets and plates of 304 stainless steel. Fabricate non-welded parts and pieces from sheets and plates of 304 stainless steel.

B. Pickle all stainless steel assemblies and parts after welding, fabrication and wire brushing by complete immersion in an acid solution as specified in ASTMA380-88. The acid shall be a nitric-hydrofluoric solution as defined in Table A2.1, Annex A2 of ASTM A380. Providing a final rinse using ordinary industrial or potable water and dry in conformance with Section 8.3 of ASTM A380. Corrosion protection techniques not employing full immersion methods are not acceptable.

C. Do all welding in the factory using MIG, TIG or plasma-arc welding inert gas processes. Field welding is not permitted.

2.2 MEMBRANE AERATION SYSTEM EQUIPMENT COMPONENTS

A. Provide expansion joints as shown on the Contract Drawings. Materials used shall be rated to withstand a 250 °F sustained temperature.

B. Provide support stands, which include hold-down, guide straps, anchor bolts, and supporting structure. Guide straps shall be a minimum of 2" wide. Supports to have a mechanism to provide for +/- 2" vertical adjustment for alignment of the manifold in the field. Supports shall be designed to allow for complete removal from the tank (less anchor bolt) to enable cleaning and maintenance of tank bottom.

C. Guide supports to consist of a self-limiting hold down and sliding mechanism. Hold down and sliding mechanism shall provide a full circumferential 2" wide contoured bearing surface with chamfered leading edges to minimize binding of the air distribution header. Sliding mechanism shall provide minimum resistance to movement of the air distribution header under full buoyant up-lit load. Mechanism to provide 1/8" clearance around header and be self-limiting if the mechanism is over-tightened. Worm gear clamps are not to be utilized for attaching header pipe to supports, and U-bolts are not acceptable.

D. Fixed supports to consist of a self-limiting hold down and sliding mechanism. Hold down and sliding mechanism shall provide a full circumferential 2" wide contoured bearing surface. Clamping device shall positively grip the air distribution header when tight and be self limiting to prevent overstressing the header if the clamp is overtightened. Worm gear clamps are not to be utilized for attaching header pipe to supports, and U-bolts are not acceptable.

E. Aligning and adjusting shall be infinitely adjustable within its limits to allow precise leveling of the air distribution headers and diffuser assemblies to within ¼"/6mm of a common horizontal plane without removing the header from the support.

F. Attach supports to tank floor with a minimum of two stainless steel expansion type anchor bolts or Hilti type chemical anchors designed for embedment in 3000 PSI concrete. Supports which utilize only one anchor bolt or one chemical anchor, or which are made of plastic are not acceptable.

G. General scope of supply for aeration diffuser systems shall be supplied by the manufacturer and meet the following requirements at a minimum;

Equipment	Material Details	
	Sludge ATAD	Post Aeration
Drop legs	304L SS Sch 10	304L SS Sch 10
Manifolds	PVC SDR 17.7 (Sch 40 equiv.)	PVC SDR 32.5 (Sch 40 equiv.)
Air Distributors	PVC SDR 17.7 (Sch 40 equiv.)	PVC SDR 32.5 (Sch 40 equiv)
Diffuser Model	SSLP (Sludge Holding) or SSII-9 (Post Aeration)	SSII-9
Supports	304L SS	304L SS

2.3 DIFFUSER ASSEMBLIES

A. Furnish disc type 9" membrane diffusers, Sanitaire SSII-9, SSLP, or acceptable equal.

B. Diffusers consist of a membrane with integral gasket, base, retaining ring, air flow control orifice, and diffuser holder.

C. Diffuser to have two connection methods to pipe

1) Threaded ¾" connection to grommet or saddle holder

D. Membrane material to be premium quality compression molded EPDM with an oil content of less than 12%. Membranes which are injection molded, or have an oil content of above 12% are not acceptable.

E. Membrane shall collapse and seal when aeration system air is turned off. Membrane shall collapse onto base when air is not being diffused. Design should permit air to exit through the entire periphery of the membrane. Membrane shall be designed to resist clogging, and should have a minimum of 6600 perforations. Membrane to be at least 70% hydrophilic. Characteristics follow:

Tensile strength	2000 PSI
Tear strength	110 Lb/linear inch
Ozone resistance	Pass
UV resistance	Pass
Durometer	60
Ultimate elongation	700%

F. Diffuser base and retaining ring to be constructed of polypropylene with organic UV stabilizers. Plastics that do not utilize UV protection shall not be acceptable. Characteristics follow:

Specific Gravity	0.905
Water absorption	0.02%
Tensile Strength	5000 PSI
Coefficient of thermal expansion	05
Maximum Temperature	100C

G. Furnish AFD Quick Connect Saddle or PVC grommets to connect diffusers to pipe. PVC saddle clamps to be attached over a 5/8"/16mm straight drilled hole. Saddle is adjustable and should be leveled upon installation to ensure that diffusers are within ¼"/6mm on a common horizontal plane. Grommets may be used as an alternative if perforations in the pipe can be drilled at exactly the same locations on the crown of the pipe. Grommet requires a 1-1/4"/31.75mm straight drilled hole. Diffuser may also be directly connected to pipe with a minimum wall thickness of 0.337"/8 mm, however this pipe thickness is required only when diffusers are directly threaded to pipe. Saddle and grommet connections may be made to Schedule 40 pipe.

H. Diffuser is designed to prevent air escape at the seal. Gasket is integral with diffuser membrane.

I. Sealing method of retaining device shall generate a minimum of 50 pounds per inch/58 Kg/cm of circumference of the sealing gasket to provide a long-term positive seal and to prevent air escape.

2.4 SPARE PARTS

A. Manufacturers shall supply 10% of the total diffusers supplied for the complete system including pipe saddles.

PART 3 – EXECUTION

3.1 GENERAL

A. All equipment shall be installed in strict accordance with the manufacturer's recommendations.

B. The Contractor shall coordinate the installation of the system with the site and structure.

C. Before starting the work, the Contractor shall lay out all details of his work, to insure the coordinated installation with the project conditions.

D. The Contractor shall arrange his work so that it will not interfere with other existing equipment or be unsightly or unworkmanlike. Any arrangements and/or relocations required for this coordinated installation shall be done by the Contractor, without extra cost to the Owner.

E. The facilities of the Town of New Windsor Caesars Wastewater Treatment Plant must be maintained in operation at all times. The adjacent units shall not be disturbed or operation interrupted.

3.2 DIFFUSER SYSTEM GRID INFORMATION

A. SLUDGE HOLDING TANK DIFFUSER SYSTEM

Grid No.	# of Trains	Grid per Train	Drop Leg Diam. (in)	Header Count	Header Spc. (ft)	Header Len (ft)	Discs per Grid	At/Ad	Discs per Train
1	1	1	4	8	3	46.58	208	14.07	208

B. POST AERATION DIFFUSER SYSTEM

Grid No.	# of Trains	Grid per Train	Drop Leg Diam. (in)	Header Count	Header Spc. (ft)	Header Len (ft)	Discs per Grid	At/Ad	Discs per Train
2	2	1	4	3	1.50	36.33	75	8.20	75

3.3 GUARANTEES

A. Written guarantees shall be provided by the Contractor for all labor and materials, for a period of one (1) year from the date of final completion and acceptance of his work, by the Owner.

B. The guarantee shall include an agreement to repair and make good, at the Contractor's expense, any or all defects which may appear in his work or materials.

3.4 SAFETY

A. The Contractor shall be responsible for providing and maintaining guards, barriers, signs and whatever services are required for the protection and safety of persons and property. In addition, the Contractor shall undertake necessary precautions and safeguards to ensure proper and safe working conditions and operating procedures.

B. The Owner nor the Engineer assume no responsibility for the Contractor's means, methods and techniques of construction, and do not assume responsibility for safety precautions incident to the completion of the project.

3.5 START-UP

A. The manufacturer of the aeration system shall furnish the services of a factory-trained Service Engineer for a minimum of one (1) day to field adjust and calibrate the equipment (or assist the Contractor in doing so). Start-up shall be deemed to include, but not be limited to, adjustment, alignment, and calibration of the equipment.

B. The time referenced in this Section for this piece of equipment, is specific to this unit and is not intended to be coincident with any other start-up or instruction time required under the Contract.

C. Any start-up time provided by the manufacturer to assist the Contractor in the completion of his work shall be deemed included in the Contract.

D. The Contractor shall be responsible for coordination of the start-up of the equipment. The Engineer shall be given a minimum of three (3) working days notice of the date of start-up and date of the manufacturer's representative's visit.

3.6 TESTING

A. Prior to the final acceptance of the work, and prior to any instruction time, the Contractor shall schedule a joint inspection with the Engineer and Owner, to demonstrate the following:

1. The equipment is complete and installed in accordance with the manufacturer's recommendations and Specifications, and is operating satisfactorily.

2. Tests performed on the equipment indicate satisfactory operation and that the equipment has been properly set, aligned and adjusted.

3.7 OPERATION AND MAINTENANCE MANUALS

A. After all start up and testing work has been completed, and the equipment is operating satisfactorily, the manufacturer of the equipment shall prepare and submit three (3) complete, original operation and maintenance (O & M) manuals.

B. Manuals shall reflect all operation, start up, maintenance and inspection functions applicable to the specific equipment furnished.

C. Manuals shall include information regarding any accessories and appurtenances furnished specific to the project, as well as any modifications or adjustments made during erection and start-up.

D. Manuals shall include complete parts lists, names and telephone numbers for the manufacturer and local representatives for all equipment, and any other pertinent data regarding replacement parts.

E. Manuals shall be furnished in bound form, in quality three (3) ring binders (or other forms found acceptable by the Owner) with identification on the face and binder as to the equipment for which it applies.

3.8 INSTRUCTION OF PLANT PERSONNEL

A. After all start up and testing work has been completed, the Contractor shall schedule a date for instruction of plant personnel, in the proper maintenance and operation of the equipment.

B. Instruction shall be performed by a qualified factory-trained service Engineer of the equipment manufacturer.

C. The Contractor shall furnish the services of the manufacturer's Engineer for a period of one (1) day for this purpose.

D. The date for the instructional class shall be as scheduled by the Owner. Operation and Maintenance (O & M) Manuals, in accordance with the requirements noted hereinabove, shall be furnished a minimum of seven (7) days prior to the class.

E. In no case shall the instructional class be held on the date when a manufacturer's representative is performing start up services.

4.0 PAYMENT

A. All work required for the complete installation and satisfactory installation, including all labor, plant, materials, equipment and specialties; concrete pad if required; miscellaneous

work; piping , valves and fittings; connections; coordination with other systems and vendors; fittings; painting; testing and start-up; placing in satisfactory operating condition; training and instruction; O & M Manuals; guarantees; and other work as necessary to complete the work herein noted, otherwise called for, shown and/or required, shall be the responsibility of the Contractor.

B. Payment shall be made under the lump sum bid in the Proposal of that Contract, unless the work is specifically called for to be provided under another contract.

END OF SECTION 465136.22

SECTION 467133 – ROTARY DRUM THICKENER

PART 1 – GENERAL

1.1 DESCRIPTION:

A. The contractor shall furnish and deliver, ready for installation, one (1) rotary drum thickener (RDT) mechanism as shown on the Contract Drawings. The rotary drum thickener will be a dual drum design, capable of thickening a slurry of wastewater solids by conditioning it with polymer and then gently turning the sludge through a series of baffled compartments to remove free water.

B. Should equipment which differs from the specifications be offered and determined to be equal to that specified, such equipment will be acceptable only on the basis that any revisions in the design and/or construction of the structure, piping, appurtenant equipment, electrical work, etc., required to accommodate such a substitution shall be made at no additional cost to the owner and be as approved by the Engineer.

1.2 PROCESS REQUIREMENTS:

A. The RDT unit shall meet the following operating parameters for the sludge type and operating condition when processing the sludge as specified:

1. Sludge Characteristics

a. Type: Combined Primary and Waste Activated Sludge
b. Feed Solids: 2 – 4%
c. Feed solids pH range: 6-8
d. Feed solids temperature range: 50-70

2. Performance Requirements

a. Minimum thickened sludge solids: 5.0 – 7.0%
b. Minimum solids capture (% SS): 95
c. Hydraulic loading rate (gpm): 195
d. Maximum polymer dosage (lbs active/ton TS): 15

1.3 REFERENCES STANDARDS:

A. The following test standards apply to the work under this section:

1. ASTM A 554 “Structural Steel”
2. ASTM A 48 “Gray Iron Castings”

3. ASTM A 536 “Ductile Iron Castings”
4. ASTM A240 “Type 304 stainless steel”
5. ASTM A 370 “Standard Test Methods and Definitions for Mechanical Testing of Steel Products”
6. AWS Structural Welding Code D1.1
7. ABMA American Bearing Manufacturer’s Association
8. IEEE Institute of Electrical and Electronic Engineers
9. ICEA Insulated Cable electric Association
10. NEC National Electric Code
11. NEMA National Electrical Manufacturers Association
12. OSHA Occupational Safety and Health Administration
13. UL Underwriters laboratory

1.4 QUALITY ASSURANCE

A. The dual rotary drum thickener (RDT) equipment shall be furnished by a single supplier who has a minimum of twenty (20) years’ experience in the manufacture of rotary drum thickeners. The equipment shall be designed, constructed and installed in accordance with the best practices and methods, and shall be equal to that manufactured by BDP Industries, Inc, or approved equal.

B. The equipment manufacturer must meet all of the following criteria:

1. All manufacturing and assembly of the rotary drum thickener (RDT) equipment must take place in the United States of America.
2. All buy-out items on the RDT shall be manufactured in the United States of America and shall be standard “off-the-shelf” mounts. The RDT manufacturer must also supply all of the original part numbers for all original equipment manufacturers’ buy-out items as well as a list of local suppliers within 150 miles of New Windsor, NY.
3. The manufacturer shall have a minimum of 20 installations of thickening equipment.
4. The manufacturer shall have a complete UL508 panel shop at their manufacturing facility in the United States. All design, manufacturing and programming shall be completed in house.
5. The RDT manufacturer shall be a U.S. corporation with all design, manufacturing and assembly at their U.S. facility. No outsourcing shall be accepted.
6. The RDT system described herein and shown on the drawings establishes a standard of required type, function and quality to be met. No “or-equal” system shall be considered by the Engineer. Any alternate equipment suppliers shall be submitted for approval 14 days prior to Bid. The submittal shall include a complete equipment submittal including room layout drawings, on site pilot test report,

electrical drawings, equipment design calculation, component catalog cuts, contact list and performance guarantee. All exceptions shall be clearly identified by the manufacturer with a cost to supply the component specified. Any exceptions not identified will lead to immediate rejection of the submittal by the engineer and owner. The cost of the engineer review shall be paid by the manufacturer submitting the alternate substitution. The cost of the review shall be billed at $250 per hour. A minimum of 40 hours will be required to review each alternate equipment submittal. The burden of proof of merit for the proposed item is upon the prospective bidder. Any modifications to the contract drawings that are required for the alternate units shall be borne by the installation manufacturer. The engineer and owner reserve the right to reject any and all alternate requests based upon on their review.

1.5 CONTRACTOR'S SUBMITTALS

A. The contractor shall submit a complete list of equipment and materials required for shop drawing or submittal approval. The term “shop drawing” as used herein shall be understood to include detailed arrangement drawings, foundation layout drawings, control drawings, catalog sheets and similar items. Unless otherwise required, these drawings shall be submitted in sufficient time to be reviewed by the engineer, and to accommodate the construction schedule required under the contract.

B. The contractor shall furnish five copies of shop drawings in three-ring binders to the engineer. Submitted packages shall include a complete bill of materials for all equipment, recommended spare parts list, list of any deviations from the contract documents and a statement of machine warranties.

C. The manufacturer shall furnish five copies of shop drawings in three ring binders to the engineer. Submitted packages shall include a complete bill of materials for all equipment, recommended spare parts list, list of any deviations from the contract documents and a statement of machine warranties.

D. The RDT manufacturer shall submit five projects in which they supplied same exact type and model RDT units on WAS secondary sludge. The engineer reserves the right to reject any and all manufacturers based on the references provided on the past projects.

E. All frame and bearing calculations shall be completed and stamped by a US State professional engineer and must be included in the equipment bid.

F. Submit shop drawings and product data required to establish compliance with this Section. Submittals shall include the following:

1. Certified shop and erection drawings showing all important details of construction, sludge feed, wash water, drainage connections, wiring diagrams, itemized motor horsepower, dimensions and anchor bolts.

2. Descriptive literature, bulletins and/or catalogues of the equipment. This material shall include, but not be limited to, the following:

    a. Functional description of internal and external instrumentation and controls to be supplied, including list of parameters monitored, controlled or alarmed and testing plan.

b. Materials of construction and of all coatings of all major components, including bearings. Include sizes of materials and thickness of coatings.

c. Details of the drive system for drums.

d. Details of the static sludge/polymer mixer supplied.

e. Information on field erection requirements, including total weight of assembled components, weight of the single largest component that will require removal during the life of the unit and gross operating weight.

f. Statement of drum, bearing, frame and media guarantees for units furnished.

g. Total connected nameplate horsepower and operating horsepower for each RDT system motor. Itemize this information for each motor.

h. Statement of water requirements (flow and pressure) and any other utility requirements.

i. Description of RDT.

3. For the baseplate of the RDT, furnish the loads including all horizontal and vertical components as follows:

a. Deadloads due to unit weight empty.

b. Deadloads due to unit weight full of sludge, drain pans full and similar circumstances.

c. Dynamic loads.

d. Combination of 2) and 3) above.

e. Control panel elevation drawings showing construction and placement of operator interface devices and other elements. Control panel data to include:

f. Dimension and layout details.

g. Materials of construction.

4. Brand names and catalog literature on all control devices such as, but not limited to:

a. Fused disconnects

b. Thermal Magnetic Circuit Breakers

c. Motor starters

d. Motor Circuit Protectors

e. Terminal blocks

f. Fuse blocks

g. Variable Frequency Drives

h. Audible and Visual Alarm Indicators.

i. All switches, pushbuttons and lights

j. Timers, relays and related equipment

k. Programmable logic controllers (PLC)

l. Surge Protection

G. Enclosures

1. A complete total bill of materials for all equipment.
2. A complete parts list, showing current price and delivery time for each part. Include manufacturer's recommended spare parts and a firm price quotation good for one (1) year after Substantial Completion.
3. A maintenance schedule, showing the required maintenance, frequency of maintenance and lubricants and other items needed at each regular preventive maintenance period.
4. Provide certified safety factor calculations as described in Paragraph 2.03 below for structural frame. These calculations shall be signed and sealed by a professional engineer licensed to practice in the United States.
5. Complete data on motors and controls as specified in Paragraph 2.12 below.
6. Addresses for alarms/data to SCADA.
7. Cut sheets on wash water booster pump and motor.

H. In the event that it is impossible to conform to certain details of this Section due to different manufacturing techniques, describe completely all non-conforming aspects.

I. Submit to the Engineer operating and maintenance data as specified. Manuals shall be provided for all RDT related equipment specified in this or other Sections. This data shall be prepared specifically for this installation and shall include all necessary Drawings, equipment lists that are required to instruct operations and maintenance personnel unfamiliar with such equipment. Approved operating and maintenance data shall be available and used during the period of operation and maintenance instructions provided by the equipment manufacturer.

PART 2 – MATERIALS:

2.1 GENERAL

A. The equipment covered by these specifications is intended to be rotary drum thickener equipment of proven ability as manufactured by reputable concerns having long experience in the production of such equipment. The equipment furnished shall be designed and constructed in accordance with the best practice and methods.

B. All components of the sludge thickening equipment shall be engineered for long continuous and uninterrupted service. Provisions shall be made for easy lubrication, adjustment, or replacement of all parts. Corresponding parts of multiple units shall be interchangeable. Except as otherwise specified, steel plates and shapes shall have a minimum thickness of 1/4" and bolts shall have a minimum diameter of 1/2".

C. All welding shall be in accordance with the latest acceptable codes of the American Welding Society ANSI/AWS D1.6.

D. All material used in the construction of the sludge thickening equipment shall be of the best

quality and entirely suitable in every respect for the service required. All structural steel shall conform to the ASTM standard specification for structural stainless steel, designation A554-MT304. All iron casting shall conform to the ASTM standard specification for gray iron casting, designation A48-76, and shall be of a class suitable for the purpose intended. Other materials shall conform to ASTM specifications where such specifications exist; the use of such material shall be based on continuous and successful use under the similar conditions of service.

E. Unless otherwise specified herein, all metal parts in contact with polyelectrolyte or sludge shall be type 304L stainless steel. All fasteners, pins, and anchor bolts shall be type 304 stainless steel.

F. All fiberglass-reinforced plastics (FRP) shall be manufactured in conformance with NBS standards PS15-69.

2.2 SURFACE PROTECTION

A. The main frame and other misc metals, excluding drives, shall be stainless steel per ASTM A554-MT304 specification. Buyouts items will be covered with the following paint system:

1. First coat of Tnemec #66 epoxy of contrasting color to a minimum of four (4) dry mils thickness.

2. Apply a second coat of Urethane top coat, finished color, minimum of four (4) mils thickness. Total thickness of the two (2) coats will be a minimum of eight (8) mils dry.

3. Flame sprayed galvanizing is not acceptable.

B. All pre-painted purchased equipment such as electrical motors, gear boxes, etc., are to be painted with a final coat of the above system.

C. The control panel enclosure shall be NEMA 4X constructed of type 304 stainless steel. The back panel located inside of the box will be white.

2.3 MAIN STRUCTURAL FRAME

A. The stainless steel frame shall be fabricated from tubular structural members designed to adequately support all components and accessories. Steel shall meet the requirements of ASTM A554-MT304; all welding shall be performed in accordance with ANSI/AWS D1.6. Where frame components are bolted, stainless steel fasteners shall be used.

B. The fabricated steel frame shall be designed to withstand the maximum stresses imposed on the individual members with a safety factor of 10. Specifically, the maximum actual stress on any member, connection, plate, etc., shall not exceed 1/10th of the yield strength of the frame material used. The deflection ratio of any structural member shall not exceed L/600 where L is the member span.

C. Side panels shall be provided when necessary to prevent spray. Drip pans shall be fabricated of a minimum 14 gauge type 304 stainless steel and shall collect filtrate from all gravity sections.

D. The frame work shall be of welded and/or bolted construction. No disassembled component, excluding the rotary drum thickener frame, shall weigh more than 2,000 lbs.

Lifting lugs shall be provided as necessary to afford convenient access to maintenance points throughout the unit.

2.4 FLOCCULATION/CONDITIONING SYSTEM

A. One (1) static, in-line, adjustable energy non-clogging Venturi mixer shall be provided. The mixer shall be equipped with a Vortex polymer injection ring with four (4) tangentially mounted polymer injectors. The mixer shall be located upstream of the RDT. The RDT manufacturer shall recommend the proper layout of the system. The contractor shall provide spool pieces of the size and number shown on the drawings at alternate locations. The in-line Venturi mixer shall be fabricated entirely of 316L stainless steel with an adjustable open throat area. The mixer shall include a removable side plate for inspection and maintenance.

B. The rotary drum thickener manufacturer shall recommend the proper layout of the system. The Contractor shall provide spool pieces of the size and number shown on the drawings at alternate locations.

C. The rotary drum thickener manufacturer shall provide an inlet manifold, constructed of schedule 80 PVC, to evenly split flow between each drum within the RDT enclosure. The manifold shall include two manual ball valves for isolating each drum to operate independently from the other.

2.5 ROTATING DRUM CONSTRUCTION

A. The RDT unit will have a single frame and enclosure that houses two (2) rotating drums with each drum an independently driven, four-foot diameter by ten-foot-long rotating cylinder. Each rotating drum drive will allow regulation of the drum revolutions per minute (rpm).

B. Each drum shall be internally baffled into a minimum of five retention compartments, oriented such as to insure passage of all the sludge through the compartments while providing retention for proper thickening. Each compartment will be wrapped with drainage media constructed of monofilament polyester filter cloth or 316 stainless steel. Porosity of the filter media for each compartment will be selected to optimize drainage rate and filtrate clarity depending upon the flocculated condition of the sludge. The filter media is held in place with type 304 or 316 stainless steel metal band clamps.

C. The total filtration area of one unit shall be 200 square feet. Each of the two (2) rotating cylinders shall have a minimum of 100 square feet of total filtration area.

D. Appleton type hand-wheel operated wire brush spray headers will be provided to continuously clean the filter media surrounding each of the five compartments for each drum.

E. The rotating drum shall be enclosed to prevent over-spray to the frame.

F. The rotating drum is of the center shaft support type and shall have bearings mounted external to the enclosure housing and located away from wetted areas.

G. Trunnion wheels/bearings that contact the outer circumference of the rotary drum and come in contact with filtrate are not allowed. Units that are constructed with an interior scroll or flights and no compartments are not acceptable.

2.6 FILTER MEDIA

A. The filter media shall be fabricated of 316 stainless steel or multifilament polyester, wear resistant plastic material selected for suitability to the process. The media design shall be selected for optimum thickening of the sludge to be processed with a minimum blinding of the filter fabric.

B. Filter media selection shall be based on the manufacturer's experience obtained at other installations thickening similar sludge with similar conditioning chemicals and also on the result of the onsite pilot demonstration. The performance data from other installations including media life together with the proposed filter media to be furnished shall be submitted to the engineer for review prior to the manufacture of the filter cloths.

C. Media will be warranted for 2,000 hours of operation. Any filter media that fails before 2,000 hours will be replaced on a prorated basis.

D. Filter media shall be designed for ease of replacement with a minimum of rotary drum thickener downtime.

2.7 FILTER MEDIA WASH SYSTEM

A. Filter media will be washed by a spray wash station. Plant effluent shall be used for the wash system. The spray wash system shall use high pressure water spray nozzles equipped with manually operated wire brushes for internal nozzle cleaning. The spray assembly shall be housed in an enclosure in a manner that limits the spray pattern within the housing assembly. The housing and nozzle assembly shall be readily removable. The housing shall be fabricated from type 304 stainless steel.

B. Wash water required shall not exceed 51 gallons per minute at 100 psi for each unit. The manufacturer shall provide a complete pressure boosting system for the RDT to achieve the above pressure.

C. The booster pump shall be a Gould Model SSH centrifugal with replaceable stainless steel shaft sleeve and casing wear ring. The motor shall be TEFC, C Face mounting with JM shaft, 5 HP, 3500 RPM, 3/60/ 460 volt. The RDT manufacture shall supply a 4-1/2 inch pressure gauge with isolation diaphragm with a scale of 40 to 200 PSI. The shower system shall include a dual basket strainer.

D. The rotary drum shower header shall be supplied with a full port electrically actuated ball valve by the RDT manufacturer. The contractor shall also supply all plumbing from the booster pump to the RDT with Schedule 80 PVC pipe.

2.8 ROTATING DRUM DRIVE

A. Each rotating drum shall have a shaft-mounted gearmotor controlled by a variable frequency drive (VFD).

B. The nominal input horsepower rating of each gear or speed reducer shall be at least equal to the nameplate horsepower of the drive motor. Drive unit shall be designed for 24 hour continuous service.

C. Each gear reducer shall be totally enclosed, water spray proof, oil lubricated with anti-friction bearings throughout. Other helical, spiral, bevel, and combination bevel helical gear reducers shall have a service factor of at least 1.25.

D. The drive shall be capable of variable speed operation controlled from the machine control panel specified hereafter. Drive shall be furnished with provisions for use on a 480 volt, 3 phase, 60 hertz power supply.

2.9 SAFETY GUARDS

A. All equipment having exposed moving parts such as fans, V-belts, gears, couplings, chains, shall be provided with safety guards as required by OSHA standards.

2.10 BEARINGS

A. The drum center journal shaft shall be supported on the inlet end by greaseable type, cam follower bearings. The discharge end shall be supported by the gearmotor assembly.

B. All bearings shall have a minimum B10 bearing life of 100,000 hours based on ANSI-B13.6-1972. The B10 bearing life of 100,000 hours shall be based on the maximum summation of all forces applied to the bearing.

2.11 DRAINAGE PANS

A. Drainage pans shall be supplied as necessary to contain all filtrate and wash water within the rotary drum thickener. Filtrate pans shall be constructed of minimum 14 gauge type 304 stainless steel.

2.12 DISCHARGE CHUTE

A. Each RDT shall be provided with a 304 stainless steel discharge chute. The chute shall include a pressure transducer for automatic level control through a speed feedback loop to the thickened sludge pump and a high level alarm.

2.13 ELECTRICAL REQUIREMENTS

A. Each rotary drum thickener unit shall be provided with a single UL508 local control panel provided by the manufacturer with provisions to interface with the plant SCADA system. Connection to the plant SCADA system will be by the electrical contractor. All electrical work shall be performed in accordance with local and national electric codes. The control panel shall be a NEMA 4X enclosure and shall contain motor overloads, motor starters, VFDs, controls and alarms for connected ancillary equipment. Each panel shall contain an Allen Bradley Compact Logix PLC and Allen Bradley 12” HMI color touchscreen.

B. Three phase, 460 volt, 60 hertz power will be supplied to the local control panels.

C. A control power transformer will be provided in the control panel to provide control power.

D. All electrical equipment controls located on the rotary drum thickener shall have NEMA 4X enclosures and wired in PVC conduit to a single common NEMA 4X terminal box.

E. All devices within the panel shall be permanently identified. Nameplates shall be provided on the face of the panel or on the individual device as required. Nameplates shall be made of laminated phenolic materials with a black face and a white core.

F. Additional push buttons and 460 volt, 60 hertz, single phase contacts shall be added for ancillary equipment, polymer feed pump, sludge feed pump, and filter cloth wash water pump.

G. Arrange local RDT control panels to allow either manual or automatic control of RDT equipment. When "MANUAL" operation is selected, all equipment associated with the RDT shall be controlled by "START/STOP" pushbuttons. When "AUTOMATIC" operation is selected, control of equipment shall be "AUTOMATIC/START" and "AUTOMATIC/STOP" pushbuttons, and programmable controller:

1. Local RDT control panels shall include OIT touchscreens with the following:

a. One control mode selector switch marked "AUTOMATIC/ MANUAL." When "MANUAL" operation is selected, all equipment associated with RDT shall be controlled by "START/STOP" pushbuttons. Provide one "START" and one "STOP" pushbutton for each of the following:

b. RDT Drive.

c. Wash Water Pump.

d. Sludge Pump Drive.

e. Polymer Pump Drives.

f. TWAS Pump Drives

g. One speed potentiometer for manual adjustment of each drive speed.

h. Digital indicators for sludge feed flow rate. Indicators shall accept 4 to 20 mADC field input and shall be calibrated in gpm.

i. Green indicating lights for "RUNNING" status for each unit operated from panel, including wash water solenoid valve energized indication.

j. Red indicating lights for "OFF" status for each unit operated from panel, including wash water solenoid valve de-energized indication.

k. One each "AUTOMATIC/START" and one "AUTOMATIC/STOP" momentary pushbuttons, for automatically starting and stopping each RDT system. TWAS pump shall be manually controlled when RDT control mode selector switch is in either the "AUTOMATIC" or "MANUAL" position.

l. One "Emergency Stop" red mushroom pushbutton.

H. Automatic Controls and Sequencing:

1. General:

a. Program the PLC for automatic control of RDT, system sequencing, and interlock functions as specified.

b. Configuration and programming of PLC system shall be responsibility of RDT manufacturer. System documentation including memory loading, I/O configuration and programming shall be provided.

c. Provide and install auxiliary relays and wiring for equipment and devices specified in this Section required for implementing functional requirements specified.

2. "AUTOMATIC Start/AutoMATIC Stop" Cycle (typical for all RDTs):

a. Automatic start cycle request to PLC shall be initiated by "AutoMATIC/START" pushbutton.

b. Control logic for an "AutoMATIC/START" cycle shall start RDT in the following order after "AutoMATIC/START" command has been initiated and interlocks are complete.

c. Wash water pump.

d. RDT Shower "Pre-Wash"

e. RDT 1 drive.

f. RDT 2 drive.

g. TWAS drive.

h. Polymer solution pump drive.

i. Sludge feed pump.

j. In "AUTOMATIC" mode the polymer system will automatically be called to dilute the neat manic polymer system.

k. Each drive shall not start until previous drive is running and necessary time delay has elapsed. The RDT manufacturer shall determine where time delays are required and shall program settings to provide smooth start-up of equipment.

l. Once all drives are confirmed running by motor run contacts from their respective starters, PLC shall cause the run indicating light to illuminate. Loss of run status contact for a drive once cycle logic is complete shall shut down RDT and associated equipment.

m. Upon "AUTOMATIC /STOP" command, system shall shut down in order that is reverse of specified start-up order with necessary time delays.

3. Interlocks: The following interlocks shall be satisfied when control mode selector switch is in either "Automatic" or "Manual" position. Failure of any one signal during start cycle or after cycle is complete shall shut down all associated RDT equipment.

a. Wash water pump must be on and sufficient wash water pressure must be sensed at a specified level.

b. TWAS hopper must be sensed at a specified level.

c. Control mode selector switch shall be in "AutoMATIC" position.

d. "Emergency Stop" pushbutton shall be in operating position.

I. Annunciation and Alarms:

1. Provide audible alarm and detailed alarm history in RDT control panel for alarming of the following:
    a. RDT 1 drive failure.
    b. RDT 2 drive failure.
    c. TWAS drive failure.
    d. Local emergency stop initiated at either RDT control panel or pull cord switch.
    e. High discharge pressure at TWAS pump.
    f. Low washwater pressure.
    g. High Sludge Feed Pump pressure.
    h. Polymer pump failure.
    i. Sludge pump failure.
    j. High TWAS level.
2. Wire all alarms to PLC system for relaying to remote location.

J. Additional stations shall be included as hereinafter specified for other ancillary drives or systems.

K. Electric motors furnished with this equipment shall be 460 volt, 3 phase, 60 hertz and shall meet the following requirements:
1. Rated for continuous duty at 40 degrees C ambient. Insulated with a minimum of Class F insulation with Class B temperature rise.
2. All motors shall be totally enclosed and non-ventilated. All motors supplied shall be rated at 150% nameplate horsepower of the required horsepower maximum service condition.

2.14 FLOW METER

A. The RDT manufacturer shall supply a totalizing flow meter as supplied by Siemens or approved equal. The flow meter shall include a 4" ANSI flange connection, a digital display, 30 feet of display cord and grounding rings.

B. The electromagnetic induction flow meter shall generate a voltage linearly proportional to flow for full-scale velocity setting from 2 to 33 feet per second. Standard accuracy of plus output shall be +/- 0.5% of rate for all meters.

C. The meter shall incorporate a high impedance amplifier of 1012 ohms or greater, eliminating the need for electrode cleaning systems the meter shall utilize bipolar pulsed DC coil excitation with auto-integrated zeroing each half-cycle. Manual zero adjustments shall not be required - even at start-up. Power consumption shall be no more than 15 VA, independent of meter size. Input power required will be from 85 to 120 VAC, 46-65 Hz, with DC input option available.

D. The power to the flow meter is 120 volt, single phase with a 2 amp breaker fed from the RDT control panel.

E. The magnetic flow meter shall be microprocessor based with integral electronics. The electronics shall be interchangeable for all sizes from 1/12" to 78". The housing is to be powder coated cast aluminum with a NEMA 4X rating.

F. The meter' s analog and pulse outputs shall be independently selected by push buttons. The analog output shall be an isolated 4-20mA DC into 700 ohms load. The pulse output shall be an open collector output \With a maximum frequency of 1,000 Hz with configurable pulse width (0.5 to 2 sec). An open collector status output shall indicate either system or process error or flow direction. An auxiliary input shall be available to positive zero return. A low flow cutoff will be standard which can be turned on or off by pushbuttons.

G. A 2-line, 16-digit LCD backlit display shall indicate flow rate and/or total flow. The totalizer value is protected by EEPROM during power outages and utilizes an overflow counter. The display shall also be capable of indicating error messages such as empty pipe condition, error condition and low flow cutoff.

2.15 SLUDGE FEED PUMP and THICKENED SLUDGE PUMP

A. The flow capacity of the sludge feed pump will be an adjustable range of 45 to 270 GPM at a differential pressure of 60 PSI when operating at a maximum speed of 300 RPM. The flow capacity of the thickened sludge pump will be an adjustable range of 20 to 140 GPM at a differential pressure of 60 PSI when operating at a maximum speed of 200 RPM. The pumps will be sized to handle a minimum 1-5/8” diameter solid.

B. Each pump will be of the positive displacement, progressive cavity type consisting of helical rotor, elastic stator, flexible joint and shaft assembly, suction and discharge ports, stuffing box with lantern ring, and drive shaft with bearings and housing. The pump will be MXQ, Seepex, or Netzsch approved equal and will be capable of continuous operation without cavitation or pulsation. It will be capable of pumping without imparting any turbulence or shearing to the sludge being pumped.

1. The helical rotor will be constructed of hard chrome plated stainless steel. The elastic stator will be vulcanized Buna-N with a minimum Durometer hardness of 65 molded inside the cast iron housing.

2. A minimum of two (2) cardan type universal joints will be used to connect the rotor to the drive shaft. Each joint will have a minimum of two (2) pins per joint and will be grease lubricated and sealed in a rubber boot for extended life and lower maintenance. Joints will be connected to the drive shaft and rotor by means of solid tapered pins and sleeves for maximum torque handling capability. The drive shaft will, be supported by both single and double row heavy duty, grease lubricated ball bearings to withstand all axial and radial loads without affecting component life expectancy.

3. Both suction and discharge ports will be ANSI 125 pound flanges for maximum resistance to pipe bending forces and deflections. The suction flange will be 5” diameter, and the discharge flange 6”. The suction flange will be rotatable in 90 degree increments to accommodate any piping configuration or later modification.

4. The pump will be furnished completely assembled and mounted on a fabricated steel base, with drive assembly.

5. The drive for the sludge feed pump will consist of an SEW Euro drive Severe Duty rated TEFC 15 HP (minimum) gear motor, with an output RPM of 300. The drive for the thickened sludge pump will consist of an SEW Euro drive Severe Duty rated TEFC 10 HP (minimum) gear motor, with an output RPM of 200. The motors will

have Class F insulation. The motor will be mounted above the pump to allow for a short foot pad. Connection between the motor and pump shaft will be belt driven. Each gear motor will be driven by a variable frequency drive, located on the control panel and will be of equal construction to the rotary drum thickener drive

2.16 POLYMER FEED SYSTEM

A. General Requirements

1. The rotary drum thickener manufacturer shall provide as a part of the total thickening equipment package, one (1) polymer feed system capable of automatically metering, diluting, activating and feeding a liquid polymer with water. Unit shall be a BDP, UGSI model M2400-P10AA or pre-approved equal.

B. Polymer Make-Down Unit

1. Polymer and water shall be mixed in a chamber designed to create sufficient mixing energy. This design shall include a progressive cavity metering pump, solenoid valve and pressure regulator.
2. The pumps shall have an adjustable speed with a variable frequency drive. The pumps shall be supplied with a 1/2 hp, 120 volt AC motor.
3. A motor driven impeller mixer shall be provided that will mix the polymer and water into solution.

C. Polymer Feed Pump

1. The polymer system shall be equipped with progressive cavity pump each capable of pumping up to 10 GPH.
2. The pump shall be designed with a high viscosity wet end pump capable of pumping neat polymer solution to the mixing chamber.
3. The pump shall be a Seepex, or approved equal.
4. The drive motor shall be a variable speed, 1/2 horsepower, complete with an SCR control unit. The SCR control unit shall have local speed adjustment, ON-OFF switch and running indication. The control unit shall provide adjustments of feed rate over a range of 20 to 1.

D. Dilution Capability

1. The primary dilution shall feed into the motorized mixing chamber and shall be capable of 2400 GPH.
2. The dilution capability shall be adjustable with a clear rotameter with a stainless steel float.
3. Furnish a solenoid valve or ON-OFF control of dilution water supply

E. Emulsion Unit Control Panel

1. The polymer system shall be supplied with a NEMA 4X control panel that provides an automated mixing system. The controls for the polymer make-down system shall be supplied in the rotary drum thickener control panel.
2. The control panel shall include all timers and relay for a complete manual and auto system. The polymer mixer chamber and metering pump shall turn on and the water solenoid valve shall open.

3. The polymer feed pump shall include start/stop indicating lights, potentiometer and local remote control.
4. The polymer mixer and polymer metering pump shall be provided with start/stop pushbuttons, indicating lights and motor starters.
5. Single phase, 120 volt, 60 Hertz power shall be supplied to the main control panel.
6. All devices within the panels shall be permanently identified. Nameplates shall be made of laminated phenolic materials with a black face and white core.

2.17 SPARE PARTS

A. The intent of this Specification is to provide uninterrupted operation for a minimum period of two (2) years. To meet this objective, the manufacturer shall supply any spare parts that are required to meet this time frame. As a minimum, the following spare parts will be furnished:
   1. One (1) drainage media
   2. One (1) set of main bearings
   3. Ten (10) spray nozzles
   4. Two (2) relays, each size and type

PART 3 – EXECUTION

3.1 DELIVERY

A. Fabricated assemblies shall be shop assembled and properly match marked for ease of field erection and then shipped in the largest sections permitted by carrier regulations.

B. All components must be erected immediately upon receipt from the manufacturer or stored in strict conformance with storage recommendations provided by the manufacturer.

3.2 SERVICES

A. Before the equipment is started, the manufacturer shall make a thorough inspection of the installation to make sure the rotary drum thickener has been installed properly and that all equipment relating to it has been installed according to the needs of the rotary drum thickener.

B. The manufacturer shall provide nine (9) days of on-site services of a qualified factory representative to place the units in operation. The owner shall assist the manufacturer by starting up and operating all support systems such as water, sludge pumping, polymer mixing and feed, electrical power and instrumentation, and other ancillary equipment as needed. This trip will be separate from training and performance. The services provided by the manufacturer shall be as detailed in the O&M manuals and shall include at a minimum the following:
   1. Check equipment alignment and assure that there are no unusual internal stresses.

2. Calibrate all instrumentation such as hydraulic systems.
3. Check lubrication in all drives.
4. Start the drives and assure they are operating properly with no binding and with correct rotation.
5. Insure that all ancillary systems have been properly adjusted, including polymer and sludge feed.

C. Start-up services shall be considered completed when the manufacturer and manufacturer have demonstrated that the units are operating without mechanical problems.

3.3 TRAINING SUPERVISION

A. During the start up procedures, the equipment manufacturer shall provide two separate trips, five days of on-site training to the owner's personnel for proper operation and maintenance of the sludge thickening equipment.

B. The manufacturer shall supply two emergency service trips to be used at the owner’s discretion as part of the service requirement at no additional cost. The service trips shall occur within 48 hour notice from the owner.

END OF SECTION 467133

SECTION 467321 - AUTOTHERMAL THERMOPHILIC AEROBIC DIGESTION SYSTEM

PART 1 - GENERAL

1.1 SCOPE

A. This Section includes the equipment and installation of all equipment, controls, and necessary appurtenances for an Autothermal Thermophilic Aerobic Digestion (ATAD) system. The work includes Two (2) ThermAer reactors, one (1) storage/nitrification/denitrification reactor (SNDR), and one (1) biofiltration odor control system. The ThermAer supplier shall provide the necessary process equipment and instrumentation. The contractor shall provide the general hardware, piping, pipe supports, and electrical equipment as specified within the contract drawings. Installation shall be performed by the contractor or contractor's representative in accordance with the contract documents.

1.2 SYSTEM DESCRIPTION

A. The system furnished under this section shall include the equipment for Two (2) ThermAer reactors, one (1) storage/nitrification/denitrification reactor (SNDR), and one (1) biofiltration odor control system as specified below and shown on the Drawings.

B. The system shall be designed to operate with the ThermAer reactor as an independent system or in series with the SNDR system, as well as the existing infrastructure on-site.

C. The system shall have three selectable modes of operation: A HAND, OFF, and AUTO switch is located on the VFD or "bucket" of each piece of equipment.

D. The system shall have the operational ability to vary the liquid depth without interruption of the aeration and jet motive mixing capability.

E. The system shall be designed to match the oxygen supply and jet pump mixing intensity to the oxygen demand, as required maintaining the optimal range of process temperatures and oxidation-reduction potential (ORP).

F. The system will also include appropriately sized and PLC controlled aeration supply systems such that odor is not a nuisance during ThermAer and SNDR operation.

1.3 DESIGN CRITERIA

A. The ThermAer system shall be designed based on the following range of solids source characteristics:

Solids Type: Thickened WAS/Primary dry pounds per day (ppd)	11,000 ppd
TS (%) average, range:	5.0% Average 4 – 6 %

VS Loading (ppd)	8,250 ppd
Amount of Thickened Sludge at 5.0% TS (gpd):	26,379
Design Dry Solids/Day (ppd):	11,000 ppd
Initial Dry Solids/Day (ppd):	7,500 ppd
Influent Solids Temperature:	>50ºF Winter
Site Elevation (ft. above sea level):	≈ 11 ft.

B. Required performance at above design influent characteristics:

1. Given initial start-up sludge quantities and characteristics as described in Paragraph A above, design ThermAer system to produce:

   a. Consistent operating temperatures ≥50° C as a weekly average.

   b. Average VS reduction 55% computed as a weekly moving average

   c. TS reduction ≥40% as a weekly average.

   d. Class 'A' Biosolids, as defined in 40 CFR Part 503.

2. Design Biofilter system to remove:

   a. Remove 99% of inlet hydrogen sulfide or maximum outlet concentration of 1 ppm.

   b. Remove 95% of inlet mercaptans or maximum outlet concentration of 1 ppm.

1.4 SUBMITTALS

A. Submit all shop drawings in accordance with Division 01 – General Requirements. Include complete assembly drawings and electrical control schematics.

B. In addition to the requirements for the plant's O & M Manual, specified elsewhere, the ThermAer manufacturer shall supply one (1) copy of electronic format of information for the Owner to utilize in operation and maintenance of the ThermAer, SNDR and biofiltration systems.

C. The O&M Manual shall include the following information for the System:

1. Warranty
2. Process Guarantee
3. Operation recommendations regarding the process
4. Installation recommendations
5. Maintenance requirements/schedule

6. Equipment drawings
7. Equipment technical data

1.5 THERMAL SUPPLIER EXPERIENCE

A. The ThermAer supplier shall have a minimum of five (5) installations operating within North America.

B. The ThermAer supplier shall have a combined ThermAer operational experience of greater than twenty (20) years.

1.6 QUALITY ASSURANCE

A. It is the intent of this specification that the equipment described herein, when installed makes a complete and effective digestion system.

B. The Contractor and ThermAer Supplier shall consult and cooperate to achieve this end.

C. The Contractor and ThermAer Supplier shall assume responsibility for proper installation and functioning of the equipment with oversight from the Engineer.

D. To assure uniform quality, ease of maintenance and minimal parts storage, it is the intent of these specifications that a single manufacturer shall supply all process equipment called for under this section.

E. All furnished equipment and systems shall conform in every respect to the requirements of the Drawings and Specifications.

1.7 WARRANTY

A. The ThermAer supplier shall provide a warranty on the equipment furnished in this section.

B. Warranties for all parts and labor shall be for one year from date of written acceptance by the Owner, not date of delivery.

1. Warranty shall include all parts and labor to correct defects.
2. Warranties by the suppliers of various components in lieu of a single source responsibility by the ThermAer manufacturer will not be accepted.

1.8 DELIVERY, STORAGE, AND HANDLING

A. The ThermAer supplier will recommend packing and preparation for shipment and handling.

B. Storage and protection will be as recommended by the ThermAer Supplier.

C. Ship each component in as few parts as possible.

1.9 SPARE PARTS

A. One (1) ORP/pH Probe

B. One (1) Blower Filter

C. One (1) set of spare belts for each pump and blower size.

PART 2 - PRODUCTS

2.1 NUMBER OF SYSTEMS

A. Two (2) ThermAer Reactor System

B. One (1) Storage/Nitrification/Denitrification Reactor (SNDR) System

C. One (1) Biofiltration Odor Control System

2.2 SCOPE OF SUPPLY

A. Below is a list of equipment specifically supplied by the ThermAer Equipment Supplier. All other components required to ensure a complete installation shall be supplied by the Contractor.

ITEM	DESCRIPTION	QTY	Equipment Tag / Comments
ThermAer Reactor	Jet Motive Horizontal end suction centrifugal Pump 52-16-100 HP	2	One (1) per ThermAer Reactor
	Sample Tap Assembly	2	One (1) per ThermAer Reactor
	Drain Valve Assembly	2	One (1) per pump
	Expansion Joints	4	Two (2) per pump
	Air Release Valve Assembly	2	One (1) per pump
ThermAer In-Basin Pip-	16 IN FRP Jet Manifold with 10 unidirectional nozzles	2	One (1) per ThermAer Reactor
	2.5 IN FRP Downcomers (In Basin)	16	Eight (8) per ThermAer Reactor Reactor

ing	16 IN SS Motive Pump Suction Bell	2	One (1) per ThermAer Reactor
	6 IN SS Motive Pump Suction Bell	2	One (1) per ThermAer Reactor
	Tank Interior Piping and Supports for FRP Air and Liquid Pipe	2 Sets	One (1) set per ThermAer Reactor
ThermAer Foam Control	14 IN Splash Cone Assembly	6	Three (3) per ThermAer Reactor
ThermAer Blowers	PD Packaged Blower GM 25 S-40 HP	2	One (1) per ThermAer Reactor
	Anti-Siphon Valve	2	One (1) per ThermAer Reactor
SNDR Reactor	Jet Motive Horizontal end suction centrifugal Pump 52-16-60 HP	1	One (1) per SNDR Reactor
	Sample Tap Assembly	1	One (1) per SNDR Reactor
	Drain Valve Assembly	1	One (1) per SNDR Reactor
	Expansion Joints	2	Two (2) per pump
	Air Release Valve Assembly	1	One (1) per pump
SNDR In-Basin Piping	16 IN FRP Jet Manifold with 10 bi-directional nozzles	1	One (1) per SNDR Reactor
	16 IN SST Jet Pump Suction Bell	1	One (1) per SNDR Reactor
	6 IN SST Transfer Pump Suction Bell	1	One (1) per SNDR Reactor
	Tank Interior Piping and Supports for FRP Air and Liquid Piping	1 Set	One (1) per SNDR Reactor

SNDR Foam Control	14 IN Splash Cone Assembly	3	Three (3) per SNDR Reactor
SNDR Blower	PD Packaged Blower GM 25 S-40 HP	1	One (1) per SNDR Reactor
SNDR Accessories	Anti-Siphon Valve	1	One (1) per SNDR Reactor
	24 IN x 24 IN Deck mounted dilution damper with actuator	1	One (1) per SNDR Reactor
Spare Blower	PD Packaged Blower GM 25 S-60 HP	1	One (1) Installed Spare
Sludge Holding Tank	PD Packaged Blower GM 25 S-60 HP	1	One (1) per Sludge Holding Tank
	Anti-Siphon Valve	1	One (1) per Sludge Holding Tank
Inlet Air Filter	12” Intake Filter	1	One (1) Per Blower System
Transfer Pumps	Rotary Lobe Pump VX-136 10 HP	2	
	Drain Valve Assembly	2	One (1) per Transfer Pump
	Expansion Joints	4	Two (2) per Transfer Pump
	Air Release Valve	1	
Heat Exchanger	Tube in Tube Heat exchanger	1	
Control Panel	Master Control Panel with AB ControlLogix	1	MCP-ThermAer
UPS	Battery Backup System	1	MCP-ThermAer-UPS

Biofilter	Biofilter Fan 22” – 30 HP	1	
	Water Panel	1	
	Scrubber Nozzles	4	
	Soaker Nozzles	20	
	12” Butterfly Dampers	2	
	16” Butterfly Damper	2	
	30” Butterfly Dampers	1	
ThermAer Instrumentation	Pressure Transmitters Assemblies with sanitary clamp and ball valve	4	Two (2) per ThermAer Jet Pump
	Temp/ORP/pH Probe	2	One (1) per ThermAer Reactor
	Pressure Liquid Level Sensor	2	One (1) per ThermAer Reactor
	Foam Level Radar Sensor	2	One (1) per ThermAer Reactor
	Vacuum Gauge	2	One (1) per ThermAer Reactor
	3” Feed Flow Meter	1	
	Seal Flow Meter	2	One (1) per ThermAer Jet Pump
SNDR Instruments and Accessories	Pressure Transmitters Assemblies with sanitary clamp and ball valve	2	Two (2) per SNDR Pump
	ORP/Temp/pH Probe	1	One (1) per SNDR Reactor

	Pressure Liquid Level Sensor	1	One (1) per SNDR Reactor
	Foam Level Radar Sensor	1	One (1) per SNDR Reactor
	Vacuum Gauge	1	One (1) per SNDR Reactor
	Seal Flow Meter	1	One (1) per SNDR Reactor
Transfer Pump and Heat Exchanger Instrumentation	Pressure Transmitter Assemblies with diaphragm seal and ball valve	4	Two (2) per Transfer Pump
	4" Flow Meter	2	
	Seal Flow Meter	2	One (1) per Transfer Pump
	Temperature Gauge	4	
	Pressure Gauge	4	
Biofilter Instruments	Temperature Probe	2	
	Vacuum Gauge	2	
	NPW Flow Meter and Transmitter	1	

2.3 ThermAer AND SNDR CONSTRUCTION AND MATERIALS.

A. Jet Aeration System

1. The ThermAer system reactor aeration equipment shall consist of one submerged jet manifold per reactor provided with in-basin liquid and air distribution piping and flush-out system per reactor.

a. Liquid recirculation shall be provided by an external dry pit centrifugal pump for each jet header system.
b. One PD blower shall be provided for the ThermAer airflow header system
c. The ThermAer supplier shall supply all in-basin liquid piping, all in-basin air piping, and necessary supports.
d. One PD blower shall be provided for as a common spare for the ThermAer and SNDR.

2. The SNDR aeration equipment shall consist of one submerged jet manifold provided with in-basin liquid and air distribution piping.

a. Liquid recirculation shall be provided by an external dry pit centrifugal pump.
b. One PD blower shall be provided for the SNDR airflow header system.
c. The ThermAer supplier shall supply all in-basin liquid piping, all in-basin air piping, and necessary supports.
d. One PD blower shall be provided for as a common spare for the ThermAers and SNDR.

3. ThermAer Jet Aeration Performance

a. The jet aeration system shall be designed to transfer sufficient oxygen to meet a total average actual oxygen requirement (AOR) of 333 lbs./hr. during the initial feed and subsequent burn mode of operation and an AOR of 71 lbs./hr. during the react mode.
b. The jet aeration system shall be designed to provide a completely mixed reactor.

4. SNDR Jet Aeration Performance

a. The jet aeration system shall be designed to transfer sufficient oxygen to meet a total average actual oxygen requirement (AOR) of 47 lbs./hr throughout the entire SNDR system.
b. The jet aeration system shall be designed to provide a completely mixed reactor.

5. Jet Aeration Manifold
a. The ThermAer aeration manifold shall be comprised of integrally fabricated liquid headers equipped with 10 jet nozzles on the in-basin header, and 3 foam nozzles on the cover.
b. The SNDR aeration manifold shall be comprised of integrally fabricated air and liquid headers equipped with 10 jet nozzles on the in-basin header, and 3 foam nozzles on the cover.
c. Jet nozzles shall be mounted equidistance on each jet manifold header.
d. ThermAer tank air shall enter each air header through 2 ½ -inch flanged connections in the tank covers.
e. SNDR tank air shall enter each air header through 8-inch flanged connections in the tank covers.
f. Recirculated liquid for the ThermAer reactor shall enter the liquid header through a 16-inch flanged connection as shown on the Drawings.
g. Recirculated liquid for the SNDR shall enter the liquid header through a 16-inch flanged connection as shown on the Drawings.
h. Liquid headers shall be cylindrical, internally smooth, and free from protrusions that might collect stringy material.

i. The ThermAer in-basin air headers shall be cylindrical and run above and perpendicular to the liquid header.
j. The SNDR in-basin air header shall be cylindrical and run above and parallel to the liquid header.
k. In-basin air piping connects to contractor supplied penetrations into reactor.
l. Liquid header in both the ThermAer and SNDR and the air header piping in both the ThermAer and SNDR shall be fabricated of corrosion resistant, machine filament wound, fiberglass reinforced thermosetting resin pipe conforming to ANSI-ASTM D-2996-88 and rated at 75 psi operating service.
m. Pipe, fittings and air feeds shall be fabricated utilizing Dow Derakane 411 vinyl ester resin, or equal

6. Jet Nozzle

a. Each jet aeration nozzle, Model TP4, shall consist of an inner liquid nozzle fabricated from Kynar and outer air/liquid discharge nozzle fabricated from fiberglass reinforced plastic using Silicon Carbide.
b. Each outer nozzle shall be lined with integral 10-20 mil nexus veil and silica carbide for added abrasion resistance. Nozzles not using an abrasion resistant liner are not acceptable.
c. The nozzles shall be of constantly decreasing cross sectional area so as to increase the velocity of the air/liquid mixture originating from the liquid nozzle and the air chamber.
d. The outlets of both the inner and outer nozzles shall be circular and shall be capable of passing a 2.2-inch spherical solid and be free from all protrusions that may collect stringy material. Inner nozzles having smaller solids passing capabilities will not be allowed.
e. The secondary, air-liquid nozzle shall have a circular orifice having a diameter of from 1.3 - 1.9 times the liquid nozzle outside diameter.

7. Distribution Piping

a. The ThermAer supplier shall provide all the air and liquid distribution piping within the basin as part of the jet system.
b. Drilling flanges (150 lb) shall be furnished for the ThermAer Supplier/Contractor interfaces at the reactor roof and wall. The Contractor shall furnish and install the wall/roof penetration, wall collar, gaskets, fasteners, and flanges, as shown on the Drawings.
c. Liquid distribution pipe at the connection point shall be 16” for the ThermAer, 16" for the SNDR tank, and connect to the in-basin flange located at the tank wall penetration pipe, as shown on the Drawings.
d. Liquid distribution pipe for the suction of the pumps at the connection point shall be 16” for the ThermAer Jet Pump, 16” for the SNDR tank, and connect to the in-basin flange located at the tank wall penetration pipe, as shown on the Drawings.
e. All pipe and fittings shall conform to ANSI/ASTM D-2996-88, be machine filament wound, be fiberglass reinforced thermosetting resin pipe rated at 75 psi service, and be fabricated utilizing an Engineer approved vinyl ester resin.
f. All distribution piping and manifold sections shall be field connected by 150 lb. flange-by-flange sets or FRP field wrap joints.

8. Pipe Support and Hardware

a. The ThermAer supplier shall provide all the necessary supports for the in-basin aeration systems, air and liquid piping for both reactors.
b. All submerged supports and connection hardware shall be constructed of 304 SS.
c. All liquid manifold supports shall consist of a contoured saddle and Schedule 40 leg assembly welded to a supporting base.
d. The Contractor shall supply all field welds required on the liquid and air piping, supports, manifold supports as shown on the drawings.
e. Air down comer supports shall consist of a contoured saddle and Schedule 40 leg assembly welded to a supporting base.
f. All support bases shall be anchored with 4-anchor bolts, grouted or cast in place, as required.
g. A contoured clamp shall hold the piping to the saddle using four threaded cap screws with lock washers. The saddle and clamp shall be provided with rubber pads to prevent abrasion.
h. Support clamps, connection hardware and anchor bolts shall be Type SS-304 stainless steel or better. Minimum service factor of the support system shall be 10:1 under a worst-case scenario.

B. Foam Control Equipment

1. Splash Cone

a. The Contractor shall supply the 14" connection through the cover of the tank.
b. The Contractor shall supply spool piece and flanged 90 degree elbow to connect splash cone to distribution piping and to allow removal of splash cone.
c. Each splash cone will connect to the liquid distribution piping through a 14" x 6" flanged connection to allow removal of the splash cone assembly.
d. Splash Nozzle

1) The Splash Nozzle shall be fabricated from UHMW PE.
2) The nozzles shall be of constantly decreasing cross sectional area so as to increase the velocity of the air/liquid mixture originating from the liquid nozzle and the air chamber.
3) The outlets of the nozzles shall be circular and shall be capable of passing a 3-inch spherical solid and be free from all protrusions that may collect stringy material.

e. The Splash cone shall be fabricated from ¾" stainless steel rod and a solid stainless steel cone.
f. The Stainless Steel rods and cone shall be heat treated.

C. Pumps

1. Pumps shall be supplied by the ThermAer supplier
2. Centrifugal Pump Construction

a. The pump shall be capable of transferring thermophilically aerobically digested or ThermAer biosolids having temperatures from 50º F. to 160º F. and Total Solids (TS) concentrations between 1% and 4%.
b. The casing shall be end suction and top discharge (self-venting) with 125 lb flanges.

c. The casing shall be a back pullout design, which allows complete disassembly without disturbing the piping or driver.
d. The casing shall be supported by rigid integral cast foot mount for maximum resistance to unanticipated loads.
e. The casing is radially split and rabbitted to the stuffing box cover and adapted to insure proper internal alignment.
f. There shall be a confined gasket located between the casing and stuffing box cover to insure a positive seal.
g. A wear plate shall be provided to protect the casing against wear and to set the impeller clearance to maintain pump efficiency at the highest levels.
h. Materials of construction for the wear plate shall be ASTM A890-3A duplex stainless steel or equivalent as a minimum.
i. The impeller shall be "open" for maximum efficiency.
j. The impeller shall be statically and dynamically balanced to ISO 1940 G6.3.
k. The impeller shall be externally adjustable by adjustment of a case mounted wear plate.
l. The impeller shall be mounted on the shaft via a spiral key assembly and locked in place using a threaded bolt and locking washer; an O-ring shall externally seal the impeller from the shaft.
m. The maximum shaft deflection shall be less than 0.002 at the face of the stuffing box.
n. The shaft shall be constructed of "SS 2324 duplex steel," or equal.
o. There shall be an adapter with rabbitted machining to insure positive alignment of the shaft to the bearing cartridge and casing cover combination.
p. The bearing cartridge shall be sealed with non-contacting isolators.
q. The isolator shall protect the bearing assembly from contamination outside sources. Oil or grease seals are unacceptable.
r. The cartridge shall be drilled on both sides to allow installation of an optional oilier. Each cartridge shall have a vent and a drain connection.
s. Bearings are to be shoulder mounted and shall not be adjustable externally.
t. The radial bearing is a cylindrical roller bearing with a minimum L10 life of 100,000 hours.
u. The axial (thrust) bearings shall be duplex 40º angular contact bearings with a minimum L10 life of 100,000 hours.
v. The bearings shall be lubricated in an oil bath.

3. Rotary Lobe Pump Construction
a. Each pump shall be of heavy duty, positive displacement rotary lobe design. The wet end shall be constructed of High Wear Resistant Special Steel. The front cover shall be constructed of 0.6025 (Grey Cast Iron), with a minimum Brinell hardness of 230 – 260, and permit removal of the rotors without disturbing piping, bearings, and mechanical seals. The case shall also be machined to accept a reversible front and rear wear plate, constructed of High Wear Resistant Special Steel, to a finished hardened reversible surface of 650-725 HB Brinell. Pumps not equipped with a removable wear plate that use the front door for its wear surface or require bolts that are recessed below the lobe path, are not acceptable for any wearing surface.
b. The pump shall utilize at minimum, HiFlo® 4-tip rotors, which are driven through positive timing gears running in oil. Solid cores of Grey Cast Iron A48, Class 40 B shall be covered with a layer of 1.0503 (Mild Steel), with a Durometer hardness 650-725 HB. The geometry of the rotor core shall be the same as that of the

finished rotor. Pulse free The rotor shall be specifically designed for pumping Sludge, Digested. Rotors shall be positioned to the shaft by replaceable hardened key ways, and secured to the shaft by internal/external expansion bolt and flush discs requiring no recesses in the end cover. Pumps utilizing lobe designs with fewer than 4 tips, will not be considered, due to the high potential for wear on the lobes, as a result of fewer sealing lines. Designs with replaceable lobe tips shall not be acceptable.

c. Both front and rear rotor case cover plates shall be fitted with a renewable hardened wear surfacing, with a minimum Brinell hardness of 650-725 HB Brinell. Rotors shall be positioned on the shaft by replaceable hardened key ways, and secured to the shaft by internal/external expansion bolt that is tightened from the inside of the support cover.

d. The shafts shall be of carbon steel ASTM A293 fitted with replaceable stainless steel sleeves where passing through the seal area. They shall be timed in their rotation by straight cut timing gears running in a separate oil chamber which also contains the ball and roller bearings for each shaft. Pumps requiring external re-timing in the event of blockage will not be considered. The shaft shall be a minimum of 85 mm in diameter where the rotors, bearings, and mechanical seals contact the shaft, to decrease the potential of torsional shaft fatigue. The use of step down, angular v-notch cut, or threaded, shafts will not be acceptable due to shaft fatigue and potential of breakage. The shaft sleeves where the mechanical seal rides, shall be removable through the front of the pump, when removing the cartridge mechanical seal, and without disturbing the surrounding piping. Maximum shaft deflection at operating pressure shall be 0.0037 inch.

e. Cartridge mechanical seals shall be provided of Seal Carrier in Mild Steel 304 Stainless Steel (1.4301) vs. Duronit for each positive displacement pump. The seal shall include the mechanical seal faces, the seal holder and carrier, all applicable o-rings, the mechanical seal faces, and stainless steel shaft sleeve. The use of manual pre-load mechanical seals will not be accepted. A blocking chamber located behind the mechanical seal, and in front of the bearing housing lip seal shall be fitted into the cartridge seal of the pump to prevent contamination of the bearings on the event of a seal failure. This chamber shall be suitable for fill, from the top of the pump, and have an external pressurized oil bottle to review the status of the mechanical seals operation, mounted on the top of the pump, located in easy view of the operator. Pumps with open to air cavities located behind the mechanical seal housing, those that require water flush or quench, or those without oil bottles, will not be accepted, due to their potential for product spill failure on the surrounding areas of the pump, and the added maintenance and cost associated with mechanical seal water flushing systems.

f. Port connections shall be ANSI Class 150 # raised face, 6 inch Gooseneck x Gooseneck designed flanges to reduce the chance of vapor locking, and increase the reliability and suction lift capability, through its unique design. They shall be hot dipped galvanized steel, for long life, and abrasion resistance.

g. The removable end cover shall be flush with no recesses or dead pockets where solids can accumulate. The cover shall be sealed with FPM (Viton) o-rings and provide complete access to the pump chamber without disconnecting pipe work glands or bearings. The removable front cover is to be mounted to the pump with 4 individual bolts to provide unhindered access to the rotors to facilitate ease of maintenance and operator safety.

h. The pump and motor shall be mounted on a steel base plate complete with necessary, guards, and mounting hardware.

i. Pumps and motors shall operate at any point within their operating range without undue noise and vibration. Vibration at any point in the operating range shall not exceed the limits allowed by the Hydraulic Institute.

j. The top and bottom housing segments of the pump shall be constructed of 0.6025 (Grey Cast Iron), hardened to a minimum of 650-725 HB Brinell, and be adjustable based on wear. The adjustment shall be accomplished by simply moving steel shims from one hole to the next in the pump housing, allowing for the closing of tolerance around the rotors. This adjustment must be available a minimum of two times from factory tolerance. The use of one-piece, block, cast housings or the use of radial wear plates will not be accepted; due to the fact that their ability to be hardened is limited and frequent replacement when a rebuild is required due to wear.

k. Bearings shall be B-10 Life, 100,000 hours. Bearings and timing gears for all pump sizes shall run in an oil chamber provided with a bolt to show the level with the centerline of the lower shaft.

l. The pump timing gears shall run in oil and shall be mounted in a gear case contiguous with the pump case. The gear case shall be fitted with oil fill and drain connections on the top and bottom. Designs that use side drains will not be acceptable, due to the inability to completely drain the fluids on the pump.

m. The manufacturer shall be ISO 9001:2008 compliant, as evidenced with a current ISO certificate at the time of bid. The pumps in the specification shall be manufactured or fully assembled in the United States of America. Manufacturers that are ISO compliant, but not certified to ISO 9001:2008, or do not fully assemble or manufacture their pumps in the USA, will not be considered.

4. Drive Unit

a. The pump motors shall be the horizontal type with normal starting torque and low starting current characteristics.

b. The motors shall be premium efficiency, 3-Phase, 60 Hz, 460 V.

c. The motors shall not be overloaded at the design condition.

d. The motors shall have copper windings and be premium efficiency suitable for variable frequency drive.

5. ThermAer Jet Motive Pump

a. Liquid recirculation shall be provided to the ThermAer jet manifold by one 100 H.P., horizontal, mixed flow, end suction centrifugal pump. The pump shall be sized to deliver 8,200 GPM @ 34 ft. TDH.

b. The pump shall be shipped with a double mechanical seal.

c. The contractor shall supply 1/2” PW feed line for the pump seal.

6. SNDR Jet Motive Pump

a. Liquid recirculation shall be provided to the SNDR jet manifold, by one 60 H.P., horizontal, mixed flow, end suction centrifugal pump. The pump shall be sized to deliver 6,500 GPM @ 25 ft. TDH.

b. The pump shall be shipped with a double mechanical seal.

c. The contractor shall supply 1/2” PW feed line for the pump seal.

7. Transfer Pump

a. Liquid recirculation shall be provided to the Transfer system, by two 10 H.P., rotary lobe pumps. The pump shall be sized to deliver 200 GPM @ 50 ft. TDH.
b. The pump shall be shipped with a single cartridge mechanical seal.

8. Pump Accessories

a. Pressure Gauge Assemblies

1) The ThermAer supplier shall supply two pressure gauge assemblies for each pump.
2) The assemblies shall be installed between the process isolation valves on the tank and pump.
3) The pressure gauge valve assembly shall be comprised of the following components: 1- 1”x4” nipple, 1-1” ball valve, 1-1”x 1.5” tri-clamp adapter.
4) The pressure gauge shall have a digital display and constructed of stainless steel. The gauges shall be -14.5-0-30 PSI on all jet pumps.
5) The diaphragm seal shall be constructed of 304 stainless steel with a 1.5” Tri-clamp process connection.
6) The valve shall be constructed of 304 stainless steel.
7) The contractor shall supply a 1” threaded connection on the suction and discharge of the piping to the pump to accommodate the pressure gauge assembly.

9. Drain Valve Assemblies

a. The ThermAer supplier shall supply one drain valve assembly on each pump suction supplied by the ThermAer supplier.
b. The assemblies shall be installed between the process isolation valve on the tank and the pump.
c. The drain valve assembly shall be comprised of the following components: 1-1”x4” nipple, 1-1” ball valve, 1-1” hosebarb.
d. The valve shall be constructed of 304 stainless steel.

10. Sample Taps

a. The ThermAer supplier shall supply one sample tap assembly for each ThermAer and SNDR tank.
b. The sample tap sludge assembly shall be comprised of the following components: 2-2” ball valves, 1-1” ball valve, 1-1” hosebarb. The Contractor shall be responsible for the 2” 304 stainless steel innerconnecting piping from the jet pump suction to the jet pump discharge..
c. The valves shall be constructed of 304 stainless steel.
d. The contractor shall be responsible for all drain piping.

D. Blowers

1. Operating Conditions

a. Name ThermAer and SNDR Process Blower

1) Quantity 3 Operating

2) Discharge Pressure 9.0 PSI

3)	Horsepower	40
4)	Max. Brake Horsepower	29.8
5)	Motor RPM	3,550
6)	Volume, SCFM	535
7)	Elevation	161’
8)	Inlet Air Temperature °F	100°F
9)	Blower RPM	3,450
10)	Blower Model Number	GM 25S

b. Name Sludge Holding Tank Blower

1)	Quantity	1 Operating, 1 Common Spare
2)	Discharge Pressure	12.0 PSI
3)	Horsepower	60
4)	Max. Brake Horsepower	44.0
5)	Motor RPM	3,560
6)	Volume, SCFM	583
7)	Elevation	161’
8)	Inlet Air Temperature °F	100°F
9)	Blower RPM	3,876
10)	Blower Model Number	GM 25S

2. Rotary Positive Displacement Blowers

a. Blower housings shall be of close-grained iron, ribbed, and of one-piece construction to ensure accurate running clearances. Bearing carriers shall be doweled to the housing for proper alignment.

b. Rotors shall be of the symmetrical, straight, three-lobe design. Rotors and shafts shall be a solid single piece, drop forged, then machined to final dimension. Materials shall be ASTM Type 1043 precision machined on all surfaces and dynamically balanced per ANSI S2.19 G6.3. First critical speeds shall not occur at or below maximum rotating speeds. Hollow rotors are not acceptable.

c. Alloy steel, single helical type, timing gears of AGMA 12 equivalent quality shall provide precise rotor synchronization, so that operating clearances are satisfactorily maintained. The AGMA service factor shall be 1.7 as a minimum at the maximum operating point. Gears shall be secured by interference fit on ground tapered shaft ends. Gears and gear end bearings shall operate in a constant oil bath for proper lubrication and long operating life.

d. The bearing selection shall be such to achieve Mean Time Between Overhauls of 5 years or more with normal maintenance. Bearings shall provide proper axial and radial rotor positioning, maintaining required clearances at all times under all rated loads. Bearing covers shall be heavy and ground, combined with ground spacers to set axial clearances, and assure uniform bearing load. The drive shaft bearing

shall be sized for an overhung V-belt drive under maximum continuous operating load. Bearing size shall be such that they will have a B-10 bearing life of 100,000 hours.

e. Each bearing shall be provided with an oil seal designed to prevent lubricant from leaking into the air stream and minimize the air leaks. 4 Rotary piston ring shaft seals, oil deflector ring, grooved multiple labyrinth bushing, and o-ring between the shaft and ring retainer shall be provided at the point where the shaft passes through the head plate. The labyrinth shall be vented to the atmosphere to eliminate any possible carry-over of lubricant into the air stream. The seal at the drive shaft shall be the only lip seal in the blower. The seal consists of: a radial lip seal riding on a replaceable shaft sleeve. Lip seals riding directly on the blower shaft are not acceptable.

3. Drive System and Motor

a. Blowers shall be arranged to be belt driven from electric motors mounted on a common motor slide base with belts suitably guarded. Motor mounts shall be such that they are tensioned automatically and shall not require adjustment.

b. Blowers shall be driven by motors and multiple V-belts with sheaves. An OSHA belt guard shall be provided. Belts shall be matched cogged type V-belts or equivalent quality. Belts shall be rated for 140 percent of motor horsepower. Sheaves shall be dynamically balanced for linear tip speeds > 6500 ft/min. The blower manufacturer shall insure that the rotation of the blower is in the proper direction.

c. Each blower shall be driven by an inverter duty rated premium efficiency, continuous duty, TEFC, 460 Volt, 3 Phase, 60 Hertz alternating current, squirrel cage induction motor. The motor shall be NEMA B design, rated for the nameplate horsepower specified in above. The motor shall be rated for full load operation in 40 degree C ambient temperature and shall have a 1.15 service factor above nameplate rating. The motor shall be suitable for continuous operation at a turn down of 3:1. The motor shall be provided with Class F insulation.

d. Motor housing construction shall be cast iron. The motor shall be horizontal, foot mounted, with anti-friction bearings suitable for use with belted loads. Motor bearings shall be sized to provide a B-10 life of 100,000 hours.

4. Blower Accessories

a. Vacuum/Pressure Gauges. Each blower shall be equipped with a vacuum gauge to measure the inlet pressure and a pressure gauge to measure the discharge pressure. The gauges shall be minimum 2-1/2 inch diameter, glycerin filled devices complete with blowout plug and shall be hermetically sealed, completely waterproof. Gauge accuracy shall be ±1% of full scale.

b. The gauges shall have stainless steel cases and rings, unbreakable polycarbonate crystals.

c. The vacuum gauges shall have a range of 0-30 inches of mercury with the smallest interval being 0.5 inches. Pressure gauges shall be calibrated for a range of 0-15 psi in 0.5 psi intervals.

d. The discharge pressure gauges shall be provided with a pressure snubber.

e. The temperature gauges, pressure gauges, and vacuum gauges shall be installed in accordance with the manufacturer's recommendations.

f. Expansion Joints. Inlet and discharge expansion joints shall be furnished and installed at each blower. An elastomer material sleeve with industrial quality clamps shall be used to connect the blower package to the plant piping. It shall be designed to withstand continuous exposure to temperatures up to 300ºF (150ºC) and pressures up to 15 psig. (1 bar g.). The distance between the package and the connecting piping shall be sufficient to allow for free thermal expansion without touching. The alignment of the piping to the package shall be accurate within ⅛". The piping shall be independently supported.

g. Vibration isolating feet and flexible pipe connectors with a minimum efficiency of 80% shall be used. When required, special mounts shall be provided for the specified seismic zone and it is the responsibility of the vendor to provide the corresponding calculations supporting the selection of the mounts.

h. Pressure Relief Valves. A field adjustable pressure relief valve shall be furnished and installed in the discharge line of each blower between the discharge silencer and the check valve. Valves shall be factory set at a relief pressure recommended by the manufacturer for the given blower operating conditions.

i. Discharge Check Valve. Discharge check valves shall be furnished and installed in the discharge line of each blower between the pressure relief valve and the discharge silencer. The valves shall be of the full-bore type and shall not use any internal spring. The check valve shall be removable without disconnecting the discharge piping. The flap shall be of a corrosion free material. The valves shall have a seat rated at 15 psig at 275 Degrees F.

j. Intake Filter/ Silencer. Each blower shall be equipped with an intake filter/silencer. The intake filter/silencer shall be heavy-duty, all welded units, constructed of heavy gauge steel suitable for outdoor installation and shall be dry element replaceable and washable type. The diameter of the outlet fitting shall be as shown on the Contract drawings. Airflow restriction gauges shall be provided for each inlet filter/silencer. The filter media shall be washable and feature an average efficiency of 90% by weight per ASHRAE 52-76 with synthetic dust.

k. Discharge Silencers. The discharge silencer shall be designed to reduce the noise emitted by the piping leaving the blower package to 85dB(A), based on a carbon steel, schedule 40 piping of a diameter equal to the blower package nominal connection size. Internal diffusers shall not be used. The silencer pressure loss shall be accounted for in the power calculation. The silencer shall feature a single shell. All welds shall be continuous. Materials of construction shall be either cast iron or pressure vessel steel. Fibrous materials or any absorption materials, which could deteriorate over time, shall not be used. A port shall be provided for inspection and cleaning.

l. Sound Attenuating Enclosures: The blower, motor, V-belt drive, silencers, and interconnecting piping between blower and silencers shall be fully enclosed by a free standing, rigid, noise reducing acoustical factory-mounted enclosure. The enclosure and the entire package it covers shall be mounted on a permanent steel skid. The skid shall serve as an oil drip pan capable of containing the entire oil volume of the blower without spillage to the surrounding environment. The skid shall allow for safe loading and unloading with a forklift truck. The enclosure shall be constructed of a series of panels. The panel material is 16 G galvanized ("Galvaneal") steel sheet, painted externally. The enclosure shall be designed so that belt tensioning, oil level checks and oil changes may be conducted without removal of the enclosure. Latched and hinged doors and lintels shall be provided on each side for this purpose. Ventilation shall be provided by a properly sized fan or vents that shall be internally baffled to prevent noise transmission. Allowable

noise levels for all blowers shall be 85 dBA when measured from a point 3 feet distant from the enclosure in a “free field”.

5. Blower System Accessories

a. Anti-Siphon Check Valve Assembly

1) The ThermAer supplier shall supply one check valve assembly per reactor to prevent reactor contents backflow into the blowers in the event of a power failure.
2) The assembly shall be installed at the highest elevation of the blower discharge piping and designed to break a liquid siphon or reverse flow by allowing air into the system as shown on the drawings.
3) The check valve assembly shall be comprised of the following components: 1- 2” nipple, 2-2” ninety degree elbows, and one check valve. All piping shall be schedule 40, 304 stainless steel.
4) The check valve shall be a 2” stainless steel elastomer hinged threaded check valve as manufactured by Techno or approved equal.
5) The Contractor shall supply a 2” threaded connection on the top of the air piping at the highest elevation of the pipe.
6) The Contractor shall supply access to the anti-Siphon check valve Assembly

b. Orifice Plate

1) The ThermAer supplier shall supply one orifice plate for each air downcomer on the ThermAer reactor to allow for even airflow across the header.
2) The orifice plate will be constructed form ¼” 304 SS plate and be sized to match a 2 ½” flange.

E. Tube and Tube Biosolids Heat Exchangers

1. Provide one heat exchanger unit to provide cooling of digester biosolids. The heat exchanger unit shall be made up of 1 chambers with 24 tubes each.
2. The unit shall be completely shop assembled prior to delivery.
3. Each Exchanger chamber shall consist of a series of 3" ID Schedule 5 stainless steel pipe biosolids tubes concentrically placed within 4" ID Schedule 10 stainless steel pipe water tubes. The tubes shall be joined by Victaulic fittings. The biosolids and water tubes shall be independently removable.
4. The biosolids tube end castings shall be removable to permit tube inspection without having to drain the jacket water. All biosolids passageways shall be designed to pass 2.5” spheres.
5. Each Chamber shall have inlet and outlet connections and shall have 2-3” connections for biosolids piping and 6-4” connections for jacket water piping. In addition, these connections shall have 1" NPT connections for attachment of biosolids and water inlet

and outlet thermometers. The connection to the process piping shall be 150 lb stainless flanges.

6. Biosolids recirculation shall be provided by the jet pumps for the heat exchanger unit. Sludge recycle rates shall be approximately 200 GPM per chamber or 200 GPM per unit. Each chamber shall have a head loss less than 20 ft.
7. The water supply shall be provided by the plant NPW system. Water flow rates shall be approximately 300 GPM per chamber or 300 GPM per unit. Each heat exchanger unit shall have a head loss less than 30 ft.

2.4 BIOFILER CONSTRUCTION AND MATERIALS

A. The system shall be designed to remove 99% of the incoming hydrogen sulfide or achieve an outlet concentration of less than 1 ppm.

B. The System shall be designed to remove 95% mercaptans or achieve an outlet concentration of less than 1 ppm.

C. Ammonia Scrubber

1. The primary humidification/scrubber unit serves three main purposes.

    a. The unit shall flush out the majority of the influent particulate and soluble constituents from the influent foul air stream.
    b. The unit shall control the foul air temperature to assure the conditions within the media are conducive to biological activity.
    c. The unit shall supply a source of humidity to raise the foul air as close to 100% relative humidity as possible

2. The contractor shall provide a 14’-6”x 8’-4” x 10' H concrete tank to be installed on site.
3. The scrubber shall have a minimum of 4 spray nozzles evenly spaced throughout the scrubber to ensure the air is in contact with water at all times.
4. Spraying Systems Company or equal shall manufacture the spray nozzles.

    a. The spray nozzles shall provide a consistent pressure drop and liquid flow to evenly distribute and atomize the scrubbing liquor spray and prevent foul air from short-circuiting.
    b. The spray nozzle arrangement shall have the capability to deliver 16 gpm at 40 PSI of scrubbing liquor per nozzle.

5. The Contractor shall supply all PVC humidification and drain piping for the scrubber.
6. The Contractor shall supply 316 SS pipe supports for the humidification piping.
7. The Contractor shall supply drain traps as shown on the Drawings.

D. Biofilter

1. The biofilter shall consist of a concrete tank, a plenum, a drain/sample port, a air flow distribution baffle and approximately eight feet of media.
2. The Contractor shall provide a 52’-8” x 26’ x 10' H concrete tank to be constructed on site.
3. The Contractor shall supply all PVC humidification and drain piping for the biofilter.

4. The Contractor shall supply 316 SS pipe supports for the humidification piping.
5. The Contractor shall supply and install a 12” trap drain as shown on the Contract Drawings.
6. The ThermAer supplier shall provide an air distribution plenum to support the biofilter media.
7. The biofilter shall have a minimum of 20 spray nozzles evenly spaced throughout the biofilter to ensure the media bed can be saturated when required.
8. The ThermAer supplier shall provide the biofilter plenum and support legs.

    a. It shall be compression molded from U.V. stabilized, 35 mesh, LLD polyethylene powder with a density of 0.932 to 0.939 (ASTM D-1693).
    b. The biofilter plenum shall be designed to support a live load of 750 lbs./sf.
    c. The airflow capacity through the floor emitters shall be a minimum of 5 scfm/sf. @ 0.2" W.C.
    d. Interlocking panels shall seal the plenum from short-circuiting. The panels have orifices specifically designed to evenly balance airflow across the entire plenum surface.
    e. The biofilter plenum shall serve as a divider between the air distribution and the media. The plenum seal shall be established by placing solid sections of polyethylene around the perimeter of the active biofilter plenum.

9. The ThermAer supplier shall provide the biofilter media. The biofilter media shall consist of one inorganic layer of haydite. The haydite media shall consist of 0.75-inch to 2-inch stones with a specific gravity between 0.9 and 1.1. The iron content of the haydite media shall provide the essential compounds necessary for the growth of microorganisms that are essential for the treatment of H_2S and mercaptans. The haydite media shall be a very stable material that does not break down rapidly.
10. The ThermAer supplier shall provide a redistribution baffle that is secured to the tank wall as shown in the drawings.
11. The ThermAer supplier shall provide the air-flow control dampers as shown in the drawings.

    a. Size, connection, Stainless Steel.
    b. 24”x24” Actuated Dilution Damper

E. Biofilter Cover

1. Biofilter Supplier shall provide aluminum cover for the biofilter as specified below. Cover shall meet the following criteria:
2. Clear span length as noted on the Construction Drawings.
3. Width as noted on the Contract Drawings.
4. Distributed Design Live Load and Deflection: All structural components shall be designed to support the dead weight of the structure, plus a live load of 50 pounds per square foot of surface.
5. The maximum deflection of any component under this load shall not exceed L/240 of the span of that component. In no event shall the dead load deflection exceed the rise of any component in order to avoid surface ponding.
6. Concentrated Live Load: The structural components shall be designed to support a 400-pound load on a 6-inch by 6-inch area located anywhere on the surface of the structure without permanently deforming the tested area.

7. Design Stresses: All allowable design stresses in structural aluminum shall be in accordance with the "Specifications for Aluminum Structures" for building-type structures by the Aluminum Association.
8. Skid Resistance: The cover shall possess an integral non-skid surface. The aluminum-decking surface of the structure shall be Hallsten's Deck Slat, which is ribbed to provide an aggressively nonskid surface. The edges of adjacent deck slats shall double interlock so that the slats shall act together. The decking surface shall be manufactured from 6061-T6 alloy. The Manufacturer of the nonskid surface shall demonstrate in writing satisfactory performance for a minimum period of 10 years in the wastewater industry for the intended purpose.
9. Chemical Resistance: Panels shall be fabricated entirely of 6061-T6 corrosion resistant aluminum extrusions. Every panel to beam connection shall be chemical resistant that will not weaken or corrode and will interlock. A mechanical and replaceable Santoprene seal shall isolate the cover perimeter from the concrete wall. No foam tape or caulk shall be allowed.
10. Configuration: The aluminum cover shall be composed of panels and beams or trusses. All panels shall interlock with the adjoining beam or truss without the use of threaded fasteners. The weight of and individual panel shall not exceed 150 pounds. Each removable panel shall be easy to remove and the lifting force required shall not exceed the dead weight of the panel.
11. Materials:

    a. Aluminum: All aluminum used in the fabrication of the cover shall be alloy 6061 T-6.
    b. All plate shall be alloy 6061-T6. Material shall be new and of first quality.

12. Welding Electrodes: Welding shall be with electrodes of an alloy, which shall produce welds with strength and corrosion resistant characteristic compatible to the base metal.
13. Fasteners: All fasteners between aluminum components shall be stainless steel or structural plastic. Fasteners between any galvanized steel components shall be hot-dipped galvanized or stainless steel. Aluminum shall be isolated from carbon steel by means of a stainless steel spacer or an elastomeric isolator or a thermoplastic powder coating. All panels and beams shall be joined with quickly removable interlocking plastic pins, which shall be removable without the use of tools.
14. Steel Accessories: Any carbon steel component shall be hot-dipped galvanized with a minimum of 2 ounces of zinc per square foot of steel surface.
15. Seals: A mechanical and replaceable Santoprene seal shall isolate the cover perimeter from the concrete wall. No foam tape or caulk shall be allowed.
16. Access Hatch Panels: Access to any location under the cover shall be gained through integral gear hinged access hatches or approved equal. The access hatch panels shall have the identical properties as the rest of the aluminum cover including loads, deflection and slip resistance specifications. Minimum size of access doors shall be 4 feet by 4 feet. The access-hinged panels shall be full panel width. Hinged panel components to include hinges, decking and lifting handles shall be extruded 6061-T6. While in the closed position the hatches shall be completely flush therefore posing no tripping hazard. In the open position the panel shall lie flat on the cover and will not need a hold open device.
17. Handles: Handles shall be an integral flush mounted aluminum and incorporated into the non-skid deck slat.

F. Biofilter System Fan

1. The belt drive In-Line Centrifugal fan shall be 22” diameter. Wheel type shall be a single thickness airfoil blade. The fan shall have non-overloading horsepower characteristics. The fan shall be packaged, completely assembled and ready to install. The discharge stack cap will be provided loose for field installation.
2. The fan housing shall be a heavy gauge commercial quality 304 stainless steel. The housing and wheel shall be continuously welded in compliance with AWS D1.1 standard. The wheels shall be commercial quality 304 stainless steel. The wheel shall be mounted to the shaft with a split taper bushing. The motor shall be mounted on a continuously welded motor base supported by four adjustable riser assemblies.
3. Fan shaft shall be fabricated of ground and polished 304 stainless steel. Bearings shall be located in an enclosed drive compartment and shall be heavy duty, self aligning, with extended lube tubes for continuous service with a minimum of 50,000 hours L-10 life. V-Belt drives shall be sized for continuous service.
4. The fan assembly shall be dynamically balanced at the factory prior to shipment. Fan shall be balanced to the American National standards Institute, Std. S2.19-1989 “Balanced Quality of Rotating Rigid Bodies”, Grade G6.3. Fan performance shall be based on tested at an AMCA accredited test laboratory in accordance with AMCA standard 210 for air performance and AMCA standard for sound.
5. Minimum Equipment Provided

    a. 22” diameter 304 Stainless steel Backward Curved Centrifugal Fan.
    b. 30 HP 1800 RPM Inverter Duty motor.
    c. Motor Cover manufactured from 304 Stainless Steel.
    d. High Plum Induced Draft Exhaust Stack manufactured from 304 Stainless Steel.
    e. Motor Base, Riser, Studs and Hard manufactured from 304 Stainless Steel.

6. Performance

    a. 10,000 SCFM @ 9” W.G.

G. Water Panel

1. The ThermAer supplier shall provide a water panel for controlling NPW water to the ammonia scrubber and biofilter secondary humidification.
2. Water panel shall be pre-assembled and include the following:

    a. 2” PVC connection for water in and two 2” PVC connections for water out.
    b. 2” flow meter.
    c. One 2”, 120-Volt motor operated modulating ball valve.
    d. One 2”, 120-Volt motor operated Open/Close ball valve.
    e. 0-100 psig pressure gauge.
    f. 2” inlet ball valve.

2.5 SYSTEM CONTROLS

A. Instruments

1. Liquid Monitoring

a. A pressure transducer level transmitter shall continuously monitor the liquid level in the ThermAer and SNDR.
b. The Contractor shall provide a 4” stainless steel flange through the sidewall of each tank.
c. The contractor shall supply a 4” plug valve.
d. The units will be supplied with a local read out to be mounted inside the equipment building.
e. The transmitter shall measure from 0 - 33feet of water, operate from 0ºC - 125ºC and have an accuracy of + 0.25%.
f. The Contractor shall provide supply electrical Beldon 8760 2-wire, 16 gauge cables.
g. The transmitters will provide 4-20 mA DC signals.
h. The unit is loop powered from the ThermAer Suppliers control panel.

2. Foam Level Monitoring

a. The non-contact radar device continuously monitors the foam level in both reactors.
b. The Contractor shall provide a 10” stainless steel flange on each tank cover for each unit.
c. The units will be supplied with a local read out to be mounted on the unit.
d. The transmitter shall measure from 0 - 66 feet, operate from 0ºC - 200ºC.
e. The Contractor shall supply electrical Beldon 8760 2-wire, 16 gauge cables.
f. The transmitter will provide a 4-20 mA DC signal.
g. The unit is loop powered from the ThermAer Suppliers control panel.

3. Retractable ORP Sensors/pH Sensors

a. The sensors shall be retractable under pressure so that maintenance and inspection can be conducted without shutdown of the process.
b. A 316 SS ball valve assembly shall be included with each sensor.
c. The sensors shall be 21" stainless steel tube.
d. The ORP sensors shall provide a measurement range of -1500 to 1500 mV with a temperature range of 5º-275º F.
e. The sensors shall be installed in the suction piping of the jet motive pumps.
f. The Contractor shall supply a 1-1/2" NPT threaded pipe connection for each unit.
g. The ThermAer supplier shall provide a local read out that consists of one analyzer for each reactor.
h. The analyzer shall be enclosure mounted.
i. The analyzers shall each have a 5.7" x 5.7" x 7.6", NEMA 4X enclosure.
j. The analyzers front panels shall include a membrane keyboard and user selectable security.
k. The power supply shall be 115VAC, 60 Hz.
l. Each sensor shall be connected to the analyzer with a flexible cable to permit removal of the sensor from the pipeline.
m. The display shall be a dual display pH and ORP.
n. The outputs shall be provided from each transmitter. Both shall be 4-20mA with HART.
o. The ORP transmitter shall measure over the range of +/- 1500 mV.
p. The pH transmitter shall measure over the range of 0 to 14.

4. Temperature Sensors

    a. The sensor continuously monitors the air temperature in the biofilter.
    b. Endress + Hauser or equal shall manufacture the instruments.
    c. The Contractor shall supply a 1/2" NPT threaded pipe connection on off gas piping.
    d. The units will be supplied with a local read out to be mounted on the unit.
    e. The transmitter shall measure from -58ºF - 393ºF.
    f. The Contractor shall supply electrical Beldon 8760 2-wire, 16 gauge cables.
    g. The transmitter will provide a 4-20 mA DC signal with HART.
    h. The unit is loop powered from the ThermAer Suppliers control panel.

5. Flow Meters

    a. A 3” flow meter shall be located in feed line as shown on the drawings.
    b. A 4” flow meter shall be located in transfer line as shown on the drawings.
    c. A 4” flow meter shall be located in NPW line as shown on the drawings.
    d. The 3” flow meter shall measure
    e. The 4” flow meter shall measure flows ranging from 0 gpm to 1100 gpm.
    f. Endress & Hauser (or equal) shall manufacture the flow tubes and transmitters.
    g. The meter shall have a Type 304 stainless steel or better flow tube; carbon steel flanges, welded steel housing and are painted with polyurethane.
    h. The flow meter’s wetted components shall include a teflon (PTFE) lining and Type 316 SS electrodes.
    i. All magnetic flow meters shall send 4-20 mA dc signals to transmitter.
    j. The transmitters shall be mounted on the wall near to the flow tube.
    k. Each transmitter shall have a local operator interface that performs all the functions necessary for programming the transmitter.
    l. The power supply to the transmitter shall require a power supply of 120 Vac.

6. Vacuum Gauge

    a. The sensor continuously monitors the air pressure of the system.
    b. The Contractor shall supply a 2" flanged connection for each unit.
    c. The units will be supplied with a local read out to be mounted on the unit.
    d. The sensor range shall be 1.5 psig.
    e. The Contractor shall supply electrical Beldon 8760 2-wire, 16 gauge cables.
    f. The transmitter will provide a 4-20 mA DC signal.
    g. The unit is loop powered from the ThermAer Suppliers control panel.

7. Pressure Gauge

    a. The sensor continuously monitors the pressure of each pump.
    b. The Contractor shall supply a 1/2" threaded connection for each unit.
    c. The units will be supplied with a local read out to be mounted on the unit.
    d. The sensor range shall be -15 to 30 psig.
    e. The Contractor shall supply electrical Beldon 8770 3-wire, 16 gauge cables.
    f. The transmitter will provide a 4-20 mA DC signal.
    g. The unit is loop powered from the pump VFD.

B. Control Panel

1. The ThermAer Control System shall be used to control all ThermAer and SNDR reactors. The operations described hereinafter are intended to identify minimum acceptable Hardware.
2. The control panel shall be NEMA 1X painted mild steel.
3. The ThermAer Control System shall consist of an Allen Bradley ControlLogix PLC, and Communications Software.

    a. The power supply, CPU, memory, I/O and communications shall be contained in a single housing. The power supply shall be AB 1756-PA72.
    b. Communications ports shall be provided for simple connectivity to computers, MMI, printers and instrumentation.
    c. These ports shall be addressed via Ethernet or the approved communication of the plant. The Ethernet card shall be AB1756-EN2T. No additional fiber optic communication shall be acceptable in the cabinet.
    d. Programs stored in battery or capacitor-backed RAM can now be backed up in safe and secure, resident EEPROM.
    e. The CPU shall be configured to have integral 24 VDC power supply, 2.5-5 ms per K logic scan, Time-of-day clock, and 9 models. The CPU shall be model AB 1756-L73.
    f. Non-volatile memory shall be provided via an EEPROM card.
    g. High-speed peer-to-peer communications shall be available, without impacting the logic program or logic scan.
    h. All digital inputs shall have dual level terminal blocks model AB 1492-JD3 wired to a digital input card model AB 1756-IA16.
    i. All digital outputs shall have a terminal block isolation relay model AB 700-HLT1L1x wired to a digital output card model AB 1756-OA16. Each isolation relay is single pole rated for 6 amps.
    j. All analog inputs shall have a tri level grounding terminal block model AB 1492-JDB3P wired to an analog input card model AB 1756-IF8H.
    k. All analog outputs shall have a tri level grounding terminal block model AB 1492-JDB3p wired to an analog output card model AB 1756-OF8.
    l. All wiring shall be color coded to decipher what power is used. 120 VAC wiring shall be red #16 MTW, 24 VDC shall be blue #16 MTW.

4. Human Machine Interface (HMI) shall consist of an Allen Bradley PanelView Plus 7 1250 on all major control areas.

    a. Shall be a touch screen.
    b. The ThermAer Control System shall include data acquisition capable of developing graphics and displaying alarms.
    c. The program shall allow for “point-click-connect” configuration.
    d. It shall be possible to make configuration revisions with the process on-line.
    e. The communications driver shall support Allen Bradley.

5. Uninterrupted Power Supply

    a. The UPS shall be able to maintain power to the control system during short duration power spikes to keep the process on-line.
    b. The UPS shall be manufactured by Allen-Bradley and be model 1609-D600N, 120 VAC UPS.

6. Motor Control

    a. Control of all VFDs connected to the ThermAer and SNDR system shall be completed over Ethernet/IP. Control of all motor starters and soft starters shall be completed with 120 VAC control wiring.

7. Remote Connection

    a. The PLC, PanelView Plus 7 and Data Logger shall have access to a Internet connection for remote connection and debugging of the system.
    b. The owner or contractor shall provide a Internet connection for remote access to the panel from a remote location.
    c. Startup, testing, and inspection of any equipment shall not begin until the internet connection as been installed and verified to be working.
    d. The internet connection will remain in service until all process guarantee criteria have been completed

C. Controls Description

1. ThermAer Primary Control with ORP

    a. An ORP probe shall be utilized for the ThermAer reactor to measure the oxidation-reduction potential. This process is US patent protected # 5,948,261 and #6,203,701 and can only be supplied by Thermal Process Systems.
    b. The ORP probe shall continuously send a signal to the process controller for primary control of the process.
    c. The speed of the pumps and blowers is adjusted based upon real time conditions in the reactor.
    d. The minimum pump and blower speed shall be set to provide standard jet nozzle mixing requirements.
    e. The maximum speed shall also be programmable, but will typically be limited by the sheave size on the pump and blower as to operate at 100% design capacity.

2. SNDR Primary Control with pH

    a. A pH probe shall be utilized for the SNDR.
    b. The pH probe shall continuously send a signal to the process controller for primary control of the process.
    c. The setting of the blower is adjusted based upon real time conditions in the reactor to promote nitrification/denitrification.
    d. The minimum pump and blower speed shall be set to provide standard jet nozzle liquid mixing requirements.
    e. The maximum speed shall also be programmable, but will typically be limited by the sheave size on the pump and blower as to operate at 100% design capacity.

3. SNDR Control with ORP

    a. An ORP probe shall be utilized for each SNDR tank to measure the oxidation-reduction potential.

b. The ORP probe shall continuously send a signal to the process controller for control of the process.
c. The speed of the pumps and blowers is adjusted based upon real time conditions in the reactor to promote nitrification.
d. The minimum pump and blower speed shall be set to not go below standard jet nozzle liquid mixing requirements.
e. The maximum speed shall also be programmable, but will typically be limited by the sheave size on the pumps and blowers as to operate at 100% design capacity.

4. SNDR Secondary Control with Temperature

a. A temperature probe shall be utilized for the SNDR to measure the reactor content temperature.
b. One RTD shall be utilized for the SNDR.
c. The RTD shall continuously send a signal to the process controller for secondary control of the process.
d. A preset minimum and maximum operating temperature shall be programmed into the controller.
e. In the event of a low temperature level an alarm shall be activated.
f. The Temperature control shall be disabled during all transfers from the ThermAer.

5. Liquid Level Monitoring

a. A pressure transducer mounted in each reactor shall continuously monitor the liquid level in feet of liquid depth.
b. The instrument is mounted in the tank side wall near the bottom of the reactor contents.
c. The primary function is to measure the reactor contents volume for process monitoring and the HRT calculation.

6. Foam Level Monitoring
a. A non-contact radar device continuously monitors the foam level in each reactor and measures the top of the foam level in feet from the tank floor.
b. The unit is mounted in the reactor cover and sends a radar wave that senses the dissolved solids in the foam as a change in density of the foam and returns to the device determining the foam layer elevation.
c. In the event of a high foam level an alarm shall be activated and the program will automatically go into the preprogrammed foam over ride.
d. The foam over ride provides a preset minimum aeration setpoint to systematically control foam and meet the oxygen demand. The system will reduce the blower speed to assure the foam does not overflow.
e. Once the system has recovered from the foam upset condition, normal ORP control will resume.

7. Actuated Valves

a. The PLC is programmed to allow remote operation of the actuated valves in the ThermAer Scope as supplied by the ThermAer supplier.
b. The valves shall be able to be independently opened and closed.

8. Operator Interface

a. A Panel View Plus 1250-touch screen shall provide the operator with all of the above-mentioned process steps and monitoring information. The typical on-screen displays shall include;

1) Temperature
2) ORP
3) PH
4) HRT
5) Pump Speed On/Off, percent operation
6) Blower Speed On/Off, percent operation
7) Liquid Level
8) Foam Level
9) Valve Positions Open/Close
10) All process equipment can be operated manually from this screen.
11) Recent feed/waste history

b. Shall be capable of communicating with an Allen Bradley ControlLogix PLC through Ethernet communications.

9. Monitor the Run Status of Equipment
   a. The PLC shall monitor the run status of every pump, blower and fan in the ThermAer Scope.
   b. The PLC shall allow turning on and off every pump, blower and fan in the ThermAer Scope.
   c. The PLC shall allow speed adjustment of every pump, blower and fan in the ThermAer Scope.

2.6 ADDITIONAL EQUIPMENT

A. Plug Valves
   1. The ThermAer system supplier shall supply plug valves and actuators as specified and shown on the Drawings.
   2. Plug valves shall meet the Engineers specifications.

B. Automatic Valve Actuators

1. Open/ Close Actuators

a. The contractor shall supply all motorized automatic valve actuators as specified and shown on the Drawings.
b. The actuators shall be provided with a contact when the valve is Open.
c. The actuators shall be provided with a contact when the valve is closed.
d. The actuators shall be provided with a contact when the valve is placed in Remote position.
e. The actuators shall be provided with a contact when actuator has faulted.
f. The actuator shall accept independent signals to both open and close the valve remotely.

2. Modulating Actuators

    a. The actuators shall be provided with a contact when the valve is placed in the Remote position.
    b. The actuators shall be provided with a contact when actuator has faulted.
    c. The actuator shall be provided with a actual position 4-20 mA signal output.
    d. The actuator shall be provided to accept a 4-20 mA command position signal.

C. Ball Valves

1. The contractor shall supply ball valves as shown on the Drawings.
2. Ball valves shall meet the Engineers specifications.

D. Butterfly Valves

1. The contractor shall supply butterfly valves on the air piping as shown on the Drawings.
2. Butterfly valves shall meet the Engineers specifications.

E. Out of Basin Liquid Piping, Supports and Accessories

1. The Contractor shall supply all out of basin liquid piping and it shall be constructed of Schedule 10 304 stainless steel or better.
2. All pipe, gaskets and accessories shall be capable of withstanding continuous exposure to 70ºC, 1500 mg/L ammonium and pH between 5 and 9.
3. The Contractor shall supply all insulation on all out-of-basin jet motive pump piping foam control piping on the ThermAer reactor.
4. The Contractor shall supply all pipe supports. Location and spacing of the supports shall be the responsibility of the contractor.
5. All pipe connections to pump flanges shall be properly supported to remove all weight from the pump flange.
6. Installation of the pipe in reference to pipe diameter, long radius elbows and fittings shall be installed with strict accordance to the ThermAer supplier drawings.
7. The top of the jet motive pumps pipe shall be on a horizontal elevation to assure that no air pockets can form.
8. Pressure gauge couplings and pressure gauges shall be supplied on the discharge pipe, and shall be isolated from the jet motive pump with 316 stainless steel ball valves.
9. One inch and a half threaded coupling is required to insert an ORP probe on the suction pipe of each Jet Motive Pump. Location of these couples will be detailed on the ThermAer supplier drawings.
10. ORP and pH probe units shall be installed at a 30° angle as measured from the top of the horizontal of the inlet suction side of the pump.
11. A one (1) inch, 316SS ball valve shall be provided in the suction piping (on the lower side) to drain suction piping for emergency maintenance of the ORP probe or pump.

F. Out of Basin Air Piping, Supports and Accessories

1. The Contractor shall supply all out of basin air piping and it shall be constructed of Schedule 10-304 stainless steel or better.
2. The Contractor shall supply all insulation shown on the drawings.
3. The Contractor shall supply all pipe supports. Location and spacing of the supports shall be the responsibility of the contractor.

4. All pipe connections to pump flanges shall be properly supported to remove all weight from the pump flange.

G. Anchor Bolts

1. The Contractor shall supply all anchor bolts of sufficient size and quantity for mounting of all equipment and piping associated with the ThermAer system that is located outside of the basin.
2. The anchor bolts shall be two-part stud and capsule system or equal.
3. The epoxy anchor shall consist of a sealed glass capsule containing pre-measured amounts of a polyester resin, quarts sand aggregate, and a hardener contained in a separate vial within the capsule.
4. Anchors shall be rated to withstand 180º F. (82º C).
5. Each anchor bolt shall be supplied with a stud, flat washer, lock washer, and nut of Type 18-8 stainless steel.

H. Expansion Joints

1. The ThermAer Supplier shall supply expansion boots and all pump flanges.
2. The expansion joints shall be spool type with either EPDM or butyl single arch high-pressure design.
3. The boots shall be full port with no internal intrusions with ANSI 150# galvanized rings.
4. They shall be mounted directly to the suction and discharge jet pump flanges, as shown.

PART 3 - EXECUTION

3.1 PREPARATION

A. The Contractor shall verify that the field conditions are acceptable and the facilities are ready to receive work.

B. The Contract shall remove all construction debris from the interior of the reactor.

C. The Contractor shall not apply any coating or material to the wall without written approval of the supplier and the engineer

D. The Contractor shall verify items provided by other sections of work are properly sized and located.

E. The Contractor shall verify that the beginning of installation means the installer accepts existing conditions.

3.2 FIELD QUALITY CONTROL

A. Installation shall be in strict accordance with the supplier’s instructions and recommendations (unless otherwise instructed by the Owner or Engineer with written notification to ThermAer supplier).

B. After completion of tank installation the reactors shall be filled with water to the operating water level by the Contractor and allowed to stand for a period of not less than 48 hours.

1. The contractor shall repair all leaks.
2. After repair, the tank shall be retested for an additional 24 hours.

C. The Contractor shall hydrostatically test all piping and valves.

1. The Contractor shall repair leaks or indications of leaks.
2. After repair, the piping shall be retested.

D. Start-Up

1. Only screened sludge is allowed to be introduced to the ThermAer Unit.
2. A qualified representative of both the Supplier and Contractor shall perform preliminary field-testing, inspection, and checkout of the entire ThermAer system, following installation.
3. Sufficient tests shall be conducted to demonstrate that all system components are fully operational.

    a. Control and instrumentation components have been calibrated and properly adjusted.
    b. All connecting piping is leak proof and properly anchored.
    c. Entire system is ready for continuous safe operation.

4. The purpose of the checkout shall be to ensure that each individual system component

    a. Has been correctly installed
    b. Shall operate fully in the manner intended.
    c. Is ready to perform its function as part of an integrated system when placed in continuous operation.

5. When all preceding equipment tests have been satisfactorily performed, when thickened sludge is available and can be suitably handled through the ThermAer system, and when so authorized by the Engineer, the ThermAer system shall be started.

    a. The Supplier shall supply the services of system-trained personnel for a minimum of three days, in not more than 1 trip to assist with the start-up of the system.
    b. The Supplier’s representative shall train the Owner’s operating personnel during the start-up period.
    c. Start-up operations shall be continued until it is satisfactorily demonstrated that the equipment is suitable for continuous on-line service.

E. Performance Testing

1. Owner shall conduct Performance Testing for the duration of the Process Guarantee, as described above.
2. Performance testing shall be scheduled to begin no longer than one month after the ThermAer system is operated in accordance with the supplier’s recommendations.
3. The system shall be operated in accordance with the recommendations of the ThermAer supplier during the performance testing.

4. A minimum of 10 biosolid samples for pathogen reduction and 10 biosolid samples for the vector attraction criteria shall be taken and tested by the Owner during the 30-day period; this, and additional testing as required, will be used to determine compliance with the performance criteria.
5. The average results of the test data will be used to determine compliance.
6. All analytical work shall be the responsibility of the Owner.
7. All analytical data shall be sent to the Owner, Engineer, and supplier within seven days of completion.
8. The Engineer shall render an opinion at completion of performance testing regarding pass/fail of the test relative to performing the above.
9. Failure shall result in remedy by supplier and other repercussions described above.
10. Retesting, as necessary, shall be by Owner.
11. Upon successfully completing the performance requirements as described above for a period of 14 consecutive days, final payment shall be made to the Supplier.

3.3 FIELD SERVICE

A. The ThermAer supplier shall provide an installation dry check consisting of:

1. Two trips for 8 man-days.
2. A qualified service engineer shall carry out all services.
3. Written service reports of each service phase shall be distributed to the Engineer and Owner.
4. Start-up.

B. The ThermAer supplier shall provide follow-up operator training, within one month of initial start-up, consisting of:

1. One trip for 2 man-days
2. Operator Instruction
3. Troubleshooting as required

END OF SECTION 467321

SECTION 467621 – BELT DEWATERING PRESS

PART 1 GENERAL

1.1 SCOPE OF WORK

A. The manufacturer shall furnish, deliver, and start-up, one (1) belt press dewatering system (referred to as "system" or "belt press system" or “dewatering system") and associated equipment as specified herein and in accordance with the Contract Documents. The belt press equipment specified in this section shall be provided by a single supplier to ensure coordination and compatibility of equipment.

B. The belt press manufacturer is advised to familiarize themselves with the overall plant process in order to evaluate the compatibility of the manufacturer's equipment to dewater the particular sludge generated.

C. The manufacturer shall provide one (1) complete Belt Press dewatering system as specified herein. The system shall include the following: belt press, polymer system, control panel, sludge feed pump, water supply booster pump, discharge chute and totalizing flow meter. The belt press system must be complete and integrated such that it can operate in a fully interlocked manner while achieving the performance requirements as specified in this document.

D. The dewatering system shall be designed to thicken and dewater wastewater sludge by means of a belt press with 3-belt design. The connected ancillary equipment shall be supplied by the Belt Press Manufacturer to ensure system compatibility and system responsibility.

1.2 ACCEPTABLE MANUFACTURERS

A. The contractor shall furnish and install Belt Press equipment as manufactured by BDP Industries, Inc., or approved equal.

B. The Contract Documents are based upon the specific dimensions and operating characteristics of the products of the manufacturer stated. Exact details of construction, operating clearances, and the like may differ between manufacturers. Provision of equivalents or substitutes, therefore, may require partial re-design or modifications of associated facilities (i.e. piping arrangement, structural dimensions, etc.), which shall be at the Contractor's own expense and shall receive approval by the Engineer.

C. It is the intent of these specifications that a single manufacturer-supplier, regularly engaged in the design, manufacture, assembly, and production of dewatering equipment, shall have complete responsibility for furnishing, coordination, and supervision of all components of the system described in this section. It is also intended that such a manufacturer-supplier make all adjustments, alterations, replacements, and tests specified and required, for a complete satisfactory, and trouble-free operating installation. The single source supplier shall provide a performance affidavit stating strict compliance with the specifications and accepting system responsibility. Furnishing of the equipment other than from a single supplier will not be allowed.

D. General:

1. In order to centralize responsibility, it is required that all equipment provided under this Section be obtained from a single supplier or manufacturer who shall assume full responsibility for the completeness of the system. The supplier or manufacturer shall be the source of information on all equipment furnished regardless of the manufacturing source of that equipment.

2. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the pump equipment manufacturer.

3. Any equipment submitted other than listed above will be considered a substitute.

1.3 PERFORMANCE CRITERIA

A. Belt Press Operational Requirements: The Belt Press (referred to as "belt press" or "press" in the remainder of this document) shall meet the following operating parameters when processing the sludge specified.

1. The solids shall be derived from aerobically digested sludge with a concentration of 5% to 8%.

2. The belt press unit shall be capable of meeting the performance criteria as set forth below:

PARAMETER	REQUIREMENT
Sludge Feed Solids (%wt)	5 - 8
Solids Loading (lbs/hr)	500
Maximum Polymer Dosage (act. lb/dry ton)	25
Minimum Discharge Cake Solids (%wt)	15
Minimum Solids Capture (%)	95

B. Process Performance Test and Guarantee

C. There will be a performance test for the dewatering test:

1. Once a representative sludge has been established, the manufacturer shall operate the press at or above the required flow rate and solids loading for a minimum period of 6 hours with samples of feed, discharge cake, and filtrate collected hourly. Samples will be analyzed per ASTM standards for total suspended solids (TSS) and total solids (TS), and the results averaged. The average cake solids must exceed the above requirements in order to demonstrate compliance. The average polymer dosage must be less than the above requirements in order to demonstrate compliance. Should the belt press fail to meet the minimum standards specified, the following shall occur:

D. Plant operating procedures shall be reviewed to determine that the sludge is in fact representative of nom1al operation and within the design specifications.

E. If it is determined that the sludge is representative and within these specifications, the manufacturer shall make any modifications necessary to accomplish the specified performance levels.

F. If the sludge can be demonstrated as representative and within specified parameters and if the manufacturer cannot meet the performance, the owner may elect to have the manufacturer remove the unit and refund any monies paid.

1.4 SUBMITTALS

A. Product Data

1. Prior to fabrication, manufacturer shall submit data for review and approval.

2. Submittal shall include shop drawings, and support data as follows: Catalog cuts sheets reflecting characteristics for major items of equipment, materials of construction, major dimensions, motor data, and pump curves including hydraulic brake horsepower (BHP).

3. Submit certified pump curves to include efficiency and horsepower curves for pump and motor.

4. Outside utility requirements, such as water, power, air, etc.

5. Functional description of any internal instrumentation and control supplied including list of parameters monitored, controlled, or alarmed.

6. Addresses and phone numbers of nearest service centers and a listing of the manufacturer's or manufacturer's representatives' services available at these locations, including addresses and phone numbers of the nearest parts warehouses capable of providing full parts replacement and/or repair services.

7. Detailed information on site, architectural, structural, mechanical, plumbing, electrical, and control, and all other changes or modifications to the design and construction work necessary to adapt the equipment or systems to the arrangement shown and/or functions described on the drawings and in the technical specifications. This shall include plan view and section sketches illustrating any additional space requirements necessary to provide the minimum adequate clear space within and around the equipment for operation and maintenance, as shown on the drawings and specified.

8. A completed and signed affidavit from the manufacturer certifying dewatering performance to performance criteria listed in Section 1.3 of this specification.

B. Shop Drawings:

1. Manufacturer's literature, illustrations, specifications and engineering data including dimensions, materials, size, weight, performance data and curves

2. Installation diagrams showing location, arrangement, and size of all anchor bolts required for the equipment, if applicable.

3. Wiring diagrams showing all electrical connections to the motors and controls.

4. Motor HP, rpm, insulation and enclosure details, and efficiency at full, 3/4 and 1/2 load.

C. Operations Maintenance Manuals

1. Installation shall be in accordance with written instructions provided by the manufacturer. Comprehensive instructions supplied at time of shipment shall enable personnel to properly operate and maintain all equipment supplied. Content and instructions shall assume operating personnel are familiar with pumps, motors, but lack experience on exact equipment supplied.

2. Three (3) copies of operation and maintenance manuals shall be furnished. The manuals shall be prepared specifically for this installation and shall include detailed operating and maintenance instructions and specifications relative to the following; assembly, alignment, checking, lubrication, placing in operation, adjustment, maintenance of each unit of equipment, auxiliaries furnished under this contract, together with complete parts lists, and copies of dimension drawings.

D. Documentation shall be specific to the pump supplied and collated in functional sections. Each section shall combine to form a complete system manual covering all aspects of equipment supplied by the pump manufacturer. Support data for any equipment supplied by others, even if mounted or included in overall station design, shall be provided by those supplying the equipment. Instructions shall include the following as a minimum:

1. Functional description of each major component, complete with operating instructions.

2. Instructions for operating equipment.

3. Calibration and adjustment of equipment for initial start-up, or as required for routine maintenance

4. Support data for commercially available components not produced by the manufacturer, but supplied in accordance with the specifications, shall be supported by literature from the prime manufacture r and incorporated as appendices.

5. Mechanical layout drawing of the equipment and components, prepared in accordance with good commercial practice, shall provide installation dimensions and location of equipment.

E. Operation and maintenance instructions which rely on vendor cut-sheets and literature which include general configurations, or require operating personnel to selectively read portions of the manual shall not be acceptable. Operation and maintenance instructions must be specific to equipment supplied in accordance with these specifications.

F. Contract Closeout Submittals:

1. Equipment Operation and Maintenance Data.

2. Manufacturer's ·warranty

3. List of recommended spare parts and tools for an operating period of one year. The list shall describe each part, the quantity recommended, and the unit price of the part.

4. Submit a written equipment alignment report for each unit.

5. Submit a written field startup report giving the results of the required field tests.

6. Submit written report of the results of each visit by a manufacturer’s serviceman, including purpose and time of visit, tasks performed, and results obtained.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Manufacturer shall have a minimum of twenty years' experience producing identical equipment and shall be able to show evidence of at least ten installations of 3-belt units of 1.0 m width (effective width), manufactured to 70 PLI design standards that meet the structural requirements of this specification. The reference installations must have been in satisfactory operation for at least five years. Upon request by the engineer, the manufacturer shall provide proof of such experience by providing installation lists, including calculations supporting the 70 PLI design that are sealed by a professional engineer. These calculations shall include the frame safety factor, bearing life and roll deflection, with calculations verifying that the design exceeds the requirements of this specification.

B. These specifications include certain areas affecting process functions, operation and maintenance reliability under which no exceptions shall be allowed. These are as follows:

1. High Strength Tubular Steel Frame Construction

2. 304 Stainless Steel Tubular Frame per ASTM 554MT-304L

3. Up-Flow Feedbox

4. Variable Speed Paddle Wheel Distributor

5. Independent Variable Speed Gravity Drainage Section at Operator Level

6. Curved Wedge Zone

7. Vertical Pressure Section

8. Machined Bearing Pads

9. Double Flange Roll Construction

10. 70 PLI Self-Compensating Hydraulic Tensioning System

11. Dual Press Drive Motors in the Pressure Section

C. The belt press manufacturer must meet all of the following criteria:

1. Full manufacturing facility and service center located within 200 miles of New Windsor, NY.

2. Shall design, build, program and test the control panel at their facility and must be a UL508 certified panel shop.

3. All buy-out items on the belt press shall be standard off-the-shelf mounts. The belt press manufacturer must also supply all of the original part numbers for all original equipment

manufacturers' buy-out items as well as a list of local suppliers located near the installed location.

D. Upon request from the engineer, the manufacturer shall prove financial stability and ability to produce the equipment within the specified delivery schedules. Evidence of facilities, equipment and expertise shall demonstrate the manufacturer's commitment to long tem1customer service and product support.

E. In order to be named as an acceptable manufacturer, or added as an alternate, the Manufacturer must provide a full equipment submittal to the Engineer for review no less than 14 days prior to the bid date to be named.

F. The manufacturer's technical representative shall inspect the completed installation, correct or supervise the correction of any defect or malfunction, and instruct operating personnel in the proper operation and maintenance of the equipment as described in Part 3 of this section.

1.6 MANUFACTURER'S WARRANTY

A. Provide a one (1) year non-prorated warranty covering all defects in materials and workmanship. Warranty shall be in effect from the date of acceptance by the owner.

B. Warranties by the suppliers of various components in lieu of a single source responsibility by the manufacturer will not be accepted. The manufacturer shall assume prime responsibility for the warranty of the complete system.

C. Components failing to perform as specified by the engineer, or as represented by the manufacturer, or as proven defective in service during the warranty period, shall be replaced, repaired, or satisfactorily modified by the manufacturer.

D. In the event the component fails to perform as specified or is proven defective in service during the warrantee period, the manufacturer shall provide a replacement part without cost to the owner. The manufacturer shall further provide, without cost, such labor as may be required to replace, repair, or modify major components such as pump, pump motors, controls, etc.

E. The manufacturer shall supply the services of a factory trained technician to inspect the installation, test the equipment for proper performance start up and instruct maintenance personnel on the operation and care of the system.

PART 2 PRODUCTS

2.1 GENERAL

A. The equipment covered by these specifications is intended to be belt press dewatering equipment of proven ability as manufactured by reputable concerns having long experience in the production of such equipment. The equipment furnished shall be designed and constructed in accordance with the best practice and methods.

B. All components of the system shall be engineered for long continuous and uninterrupted service.

Provisions shall be made for easy lubrication, adjustment, or replacement of all parts. Corresponding parts of multiple units shall be interchangeable. Except as otherwise specified, steel plates and shapes shall have a minimum thickness of ¼" and bolts shall have a minimum diameter of ½."

C. All welding shall be in accordance with the latest acceptable codes of the American Welding Society ANSI/AWS D1.6.

D. All material used in the construction of the sludge dewatering equipment shall be of the best quality and entirely suitable in every respect for the service required. All structural steel shall conform to the ASTM standard specification for structural steel, designation A36-77A. All iron casting shall conform to the ASTM standard specification for gray iron casting, designation A48-76, and shall be of a class suitable for the purpose intended. Other materials shall conform to ASTM specifications where such specifications exist; the use of such material shall be based on continuous and successful use under the similar conditions of service.

E. Unless otherwise specified herein, all metal parts in contact with or subject to splashing polyelectrolyte or sludge shall be type 304L stainless steel. All fasteners, pins, and anchor bolts shall be type 304L stainless steel.

F. All fiberglass-reinforced plastics (FRP) shall be manufactured in conformance with NBS standards PS15-69.

2.2 SURFACE PROTECTION

A. All frame metals shall be 304 Stainless Steel per the latest revision of ASTM A554MT-304L specification. No other frame materials or coatings shall not be allowed.

B. All pre-painted purchased equipment such as electrical motors, cylinders, gearboxes, etc., shall be painted with a final coat of the below system. All miscellaneous steel items shall be sandblasted and covered with the following paint system:

1. First coat of Tnemec #66 primer epoxy of contrasting color to a minimum of four (4) dry mils thickness.

2. Second coat of UV resistant Urethane Top Coat, finished color, minimum of four (4) mils thickness. Total thickness of the two (2) coats will be a minimum of eight (8) mils dry.

C. The control panel enclosure shall be NEMA 4X constructed of type 304 stainless steel. Inside of the box will be white.

2.3 MECHANICAL DETAILS

A. Main Structural Frame

1. The frame shall be fabricated from tubular steel structural members designed to support all components and accessories. Steel shall meet the requirements of ASTM A554MT-304L; all welding shall be performed in accordance with ANSI/AWS D1.1. Channel or I-beam construction shall not be accepted. Where frame components are bolted, stainless steel fasteners

shall be used. The frame moment of inertia shall be a minimum of 17 in 4 in the xx axis and 5.8 in 4 in the yy axis. The load bearing frame member of the pressure section shall have a moment of inertia minimum of 69 in.4 in the xx axis and 9 in.4 in the yy axis.

2. The fabricated steel frame shall be designed to withstand the maximum stresses imposed on the individual members with a safety factor of 10. Specifically, the maximum actual stress on any member, connection, plate, etc., shall not exceed 1/10 of the yield strength of the frame material used. The deflection ratio of any structural member shall not exceed L/600 where L is the member span. The tension used for the calculations shall be a minimum of 70 lbs. per linear inch of actual belt width.

3. Drip pans shall be fabricated of a minimum 14-gauge type 304L stainless steel and shall collect filtrate from all gravity and pressure sections.

4. The framework shall be constructed in such a manner that shall insure absolute plane parallelism of all rolling elements by machined bearing pads.

5. The framework shall be of welded and/or bolted construction. No disassembled component, excluding the belt filter frame, shall weigh more than 3,500 lbs.

6. Adjustable leakage seals shall be provided to contain the sludge on the belt through the gravity drainage zone. Seals shall be 304 stainless steel with rubber skirts, designed to provide an effective seal without causing wear to the belt.

B. Flocculation/Conditioning System

1. To achieve rapid contact between sludge particles and a solution of dilute polyelectrolyte provide:

   a. A static, in-line, adjustable energy non-clogging Venturi mixer shall be provided. The mixer shall be equipped with a Vortex polymer injection ring with four (4) tangentially mounted polymer injectors. The mixer shall be located upstream of the belt filter press. The belt filter press manufacturer shall recommend the proper layout of the system based on actual field conditions. The manufacturer shall provide spool pieces as required for alternate locations. The in-line Venturi mixer shall be fabricated entirely of 316L stainless steel with an adjustable open throat area. The mixer shall include a removable side plate for inspection and maintenance.

   b. An up-flow feedbox shall be provided after the Venturi mixer to insure optimum sludge conditioning. This feedbox shall be vertically baffled and discharged into a stainless steel distributor. The feedbox assembly shall extend across the full width of the belt press and shall be fabricated of type 304 Stainless Steel.

C. Independent Gravity Drainage Area

1. The press shall be furnished with an independent gravity drainage area consisting of a variable speed belt designed to contain and drain conditioned sludge. An inlet distributor shall be provided to evenly distribute the conditioned sludge over the face of the moving filter belt. The inlet shall incorporate a variable speed, 6-blade paddle wheel distributor across the full width of the belt press. The feed distributor must form a uniform slurry depth over the full belt width immediately upon leaving the feed distributor of plus or minus 1/16 inch. The paddle wheel

shall be driven by a 1/3 HP AC/VFD TEFC motor and gearbox. The belt system shall be sealed to prevent leakage and shall be easily accessible for operating, viewing, cleaning, and adjusting.

2. All materials in contact with the sludge in the distributor area shall be 304L stainless steel with adjustable angle furrowing plows of UHMW plastic.

3. The gravity drainage area shall have a minimum horizontal area of 31 ft2. The gravity drainage area shall be supported by slide strips. Supports shall be designed to prevent deflections greater than 0.05 inches with a loading of 100 lbs. per square foot. Slide strips shall be easily removable without disassembly of any components.

4. The belt support shall be a series of UHMW wear strips within a 304 stainless frame, spaced every 6" and be of a design to support and enhance gravity dewatering. The UHMW wear strips shall be supported by ¼" x 3" 304 stainless steel bar support. Each deck section shall be adjustable height to provide extended life of the wear strips and sludge containment seals. Only systems, which have been demonstrated as effective in the area, shall be considered.

5. Adjustable leakage seals shall be provided to contain the sludge on the belt through the gravity drainage zone. Seals shall be neoprene rubber with 304 stainless steel deckle supports, designed to provide an effective seal without causing wear to the belt.

6. Eight rows of swing up type furrowing plow devices shall be supplied in the gravity drainage section and shall be readily removable. The first two and the last two row shall be of the "Foil Doctors" design and two intermediate rows shall be an adjustable furrowing type.

7. The adjustable plows shall be mounted on a support system that can be raised for cleaning via lifting handles.

8. The Foil Doctor design shall consist of a UHMW plastic doctor blade configuration with the doctor blade held flat against the filter cloth and the knife edge pointing toward the feed box. The doctor blade shall be a minimum of 2 inches wide. Plastic supports at 12 inches spacing across the width from an overhead galvanized steel support assembly shall hold the doctor blade flat against the filter cloth. The whole assembly shall be designed to rotate up and away from the cloth.

9. Plows shall be high-density polyethylene with hot dipped galvanized support holders. Plow position shall be adjustable from 0 to 30 degrees with respect to the direction of belt travel. All plows shall be adjustable in unison for each plow row. To facilitate cleaning, each row of plows shall include a single-lifting handle; designed to raise the entire row of plows a minimum of six inches from the belt.

10. The independent gravity drainage area shall be equipped with a variable speed drive, powered and controlled from the main press panel.

11. The gravity drainage area shall incorporate an independent belt speed at operator level without the use of catwalks or rolling ladders for operations or maintenance. The gravity belt height shall not exceed four feet. All other gravity section designs shall not be permitted.

12. The independent gravity drainage area shall be provided with a hydraulic tension and tracking system as specified. Manual tensioning or tracking systems shall not be permitted.

D. Curved Wedge Section

1. The belt filter press shall be furnished with a distribution chute to receive sludge from the primary gravity dewatering section for purposes of even distribution of the sludge to the wedge section.

2. The wedge section shall be of a curved belt path design, straight belt path designs will not be allowed. The initial radius of curvature shall be a minimum of 24-inch radius and transition to a final radius of curvature of 16.5 inches. The curved section must be a minimum of 56” in length. The wedge section design shall provide gradual cake pressure through the zone to enhance dewatering. The wedge section shall be supported by construction equal to that of the gravity belt section, shall be a minimum of 2 inches wider than the width of the belt and designed to reduce belt wear.

3. Movement through the wedge section shall be designed to insure a uniform layer of sludge across the entire working width of the belt. It shall be adjustable to allow operator determination of proper relationship between belt speed and cake height, in order to insure optimum dewatering.

4. The materials in contact with the sludge and/or subject to splashing shall be fabricated from type 304L stainless steel. All fasteners, along with mounting and adjustment hardware shall be 304L stainless steel.

5. The use of vacuum assisted drainage sections shall not be permitted.

6. The wedge section shall consist of a curved wedge that shall allow for a gradual pressure increase on both belts to enhance dewatering. The wedge section shall be supported by construction equal to that of the gravity belt section, shall be a minimum of 2" wider than the width of the belt, and designed to reduce belt wear.

7. The wedge section shall have a minimum horizontal area of 20 ft2. This calculation is based on only one belt. Vertical wedges or non-curved wedges will not be accepted.

8. The curved wedge zone configuration shall include a tray beneath each roll such that the filtrate is removed from the sludge cake without filtrate hitting the return belt. Each drip pan shall be constructed of 304L stainless steel and directed to a final collection pan and piped to the sump area. The collection pans shall eliminate filtrate from landing on the returning belt.

E. Vertical Pressure Zone

1. The vertical belt filter press shall be furnished with a pressure zone following the wedge section drainage area.

2. The pressure section shall become uniform at the tangent of the first low pressure, 304L stainless steel, and perforated drainage roll. It shall be a minimum of 20” in diameter, followed by a 16” diameter reversing turn, completing a full S with each turn exceeding 200 degrees.

3. The next stage of the pressure zone shall consist of an arrangement of a minimum of five (5) rollers developing a continued 200 degree S-shaped belt travel. The rolls shall decrease from 12" in diameter to 10" in diameter.

4. The decreasing roll diameter shall provide an increasing pressure profile in the pressure zone, made adjustable by changing the belt tension.

5. The seventh and eighth roll in the pressure section shall be 10” diameter drive rollers forming the last 200 degree turn.

6. The minimum bearing size in the press section shall be 1-15/16” in diameter. The ends of each shaft on the rollers shall be equipped with support bearings as specified under bearings.

7. The pressure section shall have a minimum area of 60 ft2. This calculation shall be based on one belt in contact with the roll surface.

8. The vertical pressure zone configuration shall include a tray beneath each roll such that the filtrate is removed from the sludge cake without rewetting of the downstream cake. Each drip pan shall be directed to a final collection pan and piped to the sump area. The collection pans shall eliminate filtrate from landing on the returning belt.

F. Dewatering Belts

1. Belts shall be seamed and fabricated of monofilament polyester, wear resistant plastic material or combination monofilament polyester and stainless steel material. The mesh design shall be selected for optimum dewatering of the sludge with a minimum blinding of the filter fabric.

2. Belt selection shall be based on the manufacturer's experience obtained at other installations dewatering similar sludge’s with similar polyelectrolyte conditioning chemicals.

3. The belts shall be warranted for a minimum 2,000 hours of operation. Any belt that fails before that time, provided that the belt press has been operated per the instructions in the operation and maintenance manual, shall be replaced on a pro rata basis.

4. Each belt and connecting splice shall be designed for a minimum tensile strength equal to five times the normal maximum dynamic tension to which the belt shall be subjected. The splice shall be designed to fail before the belt.

5. Belts shall be designed for ease of replacement to minimize belt press downtime. Belt replacement shall be such that disassembly of the unit is not required.

G. Belt Wash System

1. Each filter belt shall be equipped with a belt wash station. The belt wash system shall use high-pressure water spray nozzles equipped with manually operated wire brushes for internal nozzle cleaning. The spray assembly shall be housed in an enclosure in a manner that limits the spray pattern within the housing assembly. The housing enclosure and nozzle assembly shall be readily removable and shall be fabricated from type 304L stainless steel.

2. The housing shall be sealed against the belt with rubber seals. The belt shall be protected from excessive wear by the edges of the wash station housing by replaceable guide surfaces. The belt wash station shall extend over the full width of the filter belt by a minimum of 2 inches.

3. Wash water demand shall not exceed 50 GPM at 120 psig. The dewatering system manufacturer shall provide two complete pressure boosting systems for the presses to achieve

the required pressure. The wash water and pressure boosting system shall be designed by the dewatering system manufacturer based on the system requirements.

4. The booster pumps shall be a centrifugal type pump with replaceable stainless steel shaft sleeve and casing wear ring. The impeller shall be equipped with a high pressure O-ring seal. The motor shall be a standard NEMA frame, C Face mounting with JM shaft, maximum of 10 HP, 3500 RPM, 240 volt, 60 hertz, 3-phase power, with a TEFC enclosure. The belt press manufacture shall supply a 4-1/2 inch pressure gauge with isolation diaphragm with a scale of 0 to 200 PSI. The wash water booster pump shall be a Goulds model eSH or equal. The shower system shall include a dual basket Titian strainer.

5. All piping from the booster pumps shall be Schedule 80 PVC pipe.

H. Belt Alignment System

1. The belt aligning devices shall be hydraulically operated to align each belt and locate it centrally on the rollers by means of a sensing arm. Pneumatic systems shall not be permitted. This arm shall operate a pilot valve, which shall modify the position of the hydraulic actuator. The actuator shall be connected to a pivot belt-aligning roller, causing this roller to skew from its traverse position.

2. The alignment system shall function as a continuous automatic belt guidance system and shall be an integral part of the press. The alignment system shall operate with smooth and slow motions resulting in a minimum of belt travel from side to side. The use of electric servos shall not be permitted.

3. Backup limit switches for the belt aligning system shall be provided with sufficient contacts to de-energize all drives and sound an alarm in case of a belt over travel.

4. A complete simplex hydraulic system shall be provided. This system shall include pump, 3 HP TEFC motor, valves, 20-gallon 304 stainless steel storage reservoir, all controls and piping as necessary to provide a complete and functional system. The pump shall be an adjustable flow and pressure vane pump. The unit shall include a low-pressure switch, system pressure gauge, temperature gauge, and tank level gauge. The system shall include a high-pressure line filter and low-pressure return filter. The hydraulic unit shall be floor mounted away from the press to eliminate wash down spray. A minimum of ½" 316L stainless steel tubing shall be provided from the hydraulic unit to the press.

5. The hydraulic unit shall be supplied with a 304L stainless steel support stand to allow for the tank oil to be easily drained. The tank shall also include a 304L stainless steel drain valve to allow for draining of the hydraulic oil.

6. All hydraulic lines and fittings shall be 316L stainless steel and rigidly supported on the structural frame and properly sized for the intended use with adequate factors of safety for the rated pressure.

7. All belt alignment control equipment shall be fabricated from aluminum or stainless steel. The hydraulic cylinders shall be composite material with stainless steel rods and hardware.

I. Belt Tensioning System

1. Each belt shall be provided with a belt tensioning system. The belt tensioning system shall be hydraulically actuated and shall be such that the dewatering pressure is directly proportional to belt tension and that adjustments in the tension shall result in immediate changes in dewatering pressure. Manual or electric servo tensioning systems are shall not be permitted.

2. Each belt tensioning system shall be furnished with an individual control station such that independent adjustment for each belt is possible. The control stations shall incorporate an on/off selector, calibrated pressure regulating valve and a pressure gauge to indicate actual operating pressure on each system.

3. The design of the belt tensioning system for the pressure section shall insure parallel movement of the cylinders on each end of the tensioning roller by use of a rack and pinion assembly. The gravity belt tensioning roller shall be mounted on a rugged yoke assembly, with hydraulic cylinders at each end. Plastic components will not be accepted. The belt tensioning system shall accommodate a minimum of 2.5% increase in belt length. The system must be capable of producing up to 70 PLI belt tension at a system pressure of 1,000 PSI or less.

4. Sensing devices shall be furnished to determine belt travel beyond normal operating limits. The sensing devices shall be electrically connected within the alarm system to cause "an alarm shut down". Manual reset of the system shall be required.

5. The hydraulic cylinders shall be composite cylinders with stainless steel hardware. The cylinder rods shall be constructed with 316 stainless steel.

J. Press Drives

1. The three belt drives shall be 2 HP gravity drive and dual 1.5 HP press section drive. Each shall be variable speed with a variable frequency AC drive unit. The feedbox paddle wheel shall be driven by 1/3 HP AC/VFD drive. Speed indicator readout for each shall be installed in the main press control panel. All motors shall be TEFC.

2. The gravity belt drive shall be capable of varying output speed from 8 to 75 feet per minute and the press section drive, 3 to 15 feet per minute.

3. The nominal input horsepower rating of each gear or speed reducer shall be at least equal to the nameplate horsepower of the drive motor. Each drive unit shall be rated IP65 and designed for 24-hour continuous service.

4. Each gear reducer shall be totally enclosed, water spray proof, oil lubricated with anti-friction bearings throughout.

5. The drives shall operate on 240 volt, 60 hertz, 3-phase power supply.

6. The belt drive for the pressure section shall be driven by a single roller. The gearbox shall be shaft mounted. Spur gears or chain driven rollers shall not be permitted.

K. Safety Guards

1. All equipment having exposed moving parts such as fans, V-belts, gears, couplings, chains,

and including the pressure roll section, shall be provided with safety guards as required by State, Local and OSHA standards. All safety guards shall be of a minimum Type 304 stainless steel construction or better.

L. Discharge Blades

1. Discharge blades shall be provided to scrape dewatered sludge from the belt at the final discharge rollers. The doctor blade shall be made of wear resistant UHMW plastic. The blades shall be readily removable. The blade holders shall be secured in place by means of counterweights. Spring tension type fasteners shall not be permitted.

2. The minimum discharge height shall be 6'6" high. If necessary, the belt presses and catwalks shall be supplied with additional support legs by the press manufacturer.

M. Bearings

1. The shafts of all rollers shall be equipped with heavy-duty grease-able type, roller bearings in sealed, split case bearing housings. All bearings in the press shall be spherical roller bearings. The housings shall allow the changing of the bearings without changes in the factory alignment of the roller. The housing shall be sealed to provide adequate sealing from moisture and grime with closed end housing. The outside of the housing on tracking roller bearings shall also incorporate a stainless steel sealed end cap. The bearing housing seal shall incorporate a triple lip, nitrile seal mechanism to eliminate contamination.

2. All bearings shall have a minimum B 10 bearing life of 1,000,000 hours based on ANSI B13.6 1972. The B 10 bearing life of 1,000,000 hours shall be based on the maximum summation of all forces applied to the bearing. The forces shall include both belts at a belt tension of 70 PLI each, maximum belt speed of 15 ft/min and torque of the drive motor.

3. Bearings and housings shall be US manufactured and shall be manufactured by FMC Corporation, Link-Belt Division, Indianapolis, Indiana; Reliance Electric Company, Dodge Division, Greenville, South Carolina: or equal.

4. All bearings shall be manufactured and supplied with off the shelf bearings and housings from the above manufacturers with original part numbers. Any manufacturers that supply only their belt press manufacturer part number, provide custom bearing manufacturing, or manufacture the bearing housing will not be considered.

N. Rollers

1. All rollers shall be of solid steel or double-separated plate stub end shaft construction. The stub end shafts and roller heads shall be welded in place. Bolted and or through shaft roll construction shall not be permitted. All rollers shall be designed to have a maximum deflection of 0.05 inches at their center when under maximum loading.

2. All rollers except drive and tracking rolls shall be of carbon steel construction, coated with a minimum of 30 mils of thermoplastic nylon, selected by the press manufacturer. Drive and tracking shall incorporate 50 mils of thermoplastic nylon with a 65 Durometer surface or 3/8" vulcanized rubber for abrasion resistance and proper belt tracking and drive. Other types of roller coatings shall not be permitted.

O. Drainage Pans

1. Drainage pans shall be supplied as necessary to contain all filtrate and wash water within the belt filter press and to reduce rewetting of downstream cake. Filtrate and wash water pans shall be constructed of minimum 14-gauge type 304L stainless steel. All drainage piping shall schedule 80 PVC, adequately sized for the intended service and rigidly attached to the press frame.

2.4 ELECTRICAL REQUIREMENTS

A. General Requirements

1. Provide belt press master control panel constructed of 304 stainless steel, NEMA 4X construction.

2. The Master Control Panel shall include an Allen Bradley 12" color Panel View Plus 7 touch screen for control of all system components including each press, the hydraulic units, wash water booster pumps, polymer make-down unit, sludge feed pumps, feed box motor drive, gravity section drive, and pressure section drive. The master control panel shall include the VFDs for the polymer feed pumps, feedbox, gravity section drive and pressure section drives. The sludge pump VFDs shall be NEMA 4X and externally mounted to the exterior of the master control panel. The control panel shall include motor starters for the hydraulic unit and wash water booster pump. The control panel shall include an Allen Bradley Compact Logix PLC with Ethernet communication and such ancillary drives as hereafter specified.

3. Three phase, 240 volt, 60-Hertz power shall be supplied to the control panels A control transformer will be provided for 120-volt, single phase power source for motor starter coils, lights, relays, timers, controllers, and other related items.

4. Each control panel shall be provided with terminal blocks for power wiring to and from the panel. The incoming terminal blocks shall be provided with a single magnetic circuit breaker disconnect switch. Circuit breaker protected motor starters with thermal overloads shall be supplied for each motor furnished with the unit.

5. All electrical equipment controls located on the belt press shall have NEMA 4X enclosures and wired, through PVC conduit, to a single common NEMA 4X terminal box.

6. All devices within the panel shall be permanently identified. Nameplates shall be provided on the face of the panel or on the individual dev ice as required. Nameplates shall be made of laminated phenolic materials with a white face and a black core.

7. The panel shall be designed for manual starting and stopping of all drives. A master manual/ auto system switch shall be supplied to override the alarm system and allow operation of any drive through a momentary contact pushbutton. The control panel shall contain start/stop pushbuttons, run lights, and alarm indications for the sludge pumps, polymer systems, conveyors and the booster pumps.

8. The operator interface terminal (OIT) touchscreen shall be equipped with a start/stop switch and run light for each adjustable piece of equipment. The belt drives, feedbox drive, polymer system and sludge pump drives as hereafter specified, shall also incorporate speed control and speed indication. The control panel shall include start/ stop pushbutton, run lights, speed control

and 4 to 20 mA signal generators for the polymer solution and sludge pumps controls.

9. Alarm lights, sensors, and related circuitry shall be provided for the following functions: zero speed, emergency stop push button on each side of the press, low water pressure, and low hydraulic pressure. In the event of any of the above malfunctions, the machine will shut down and an alarm sound. The alarm system shall include an audible horn rated at 90 DBA at IO'. The system shall include silencing provisions, but the function alarm indicating light shall remain lit until the alarm condition is satisfied. A separate set of alarm contacts shall be provided for remote alarm indication

10. Arrange control panel to allow either manual or automatic control of belt press equipment. When "MANUAL" operation is selected, all equipment associated with the belt press shall be controlled by "START/STOP" pushbuttons on the touchscreen. When "AUTOMATIC" operation is selected, control of equipment shall be "AUTOMATIC/START "and " AUTOMATIC/STOP" pushbuttons on the touchscreen, and programmable controller:

    a. Master control panel shall include OIT touchscreens with the following:

        a) One control mode selector switch marked "AUTOMATIC/ MANUAL." When " MANUAL" operation is selected, all equipment associated with belt press shall be controlled by " START/STOP" pushbuttons. Provide one " START " and one " STOP" pushbutton for each of the following:

            I. Feedbox Drive.

            II. GBT Drive.

            III. Press Drive.

            IV. Hydraulic Unit.

            V. Wash Water Pump.

            VI. Sludge Pump Drives

            VII. Polymer System Drive.

        b) One speed potentiometer for manual adjustment of each drive speed.

        c) Digital indicators for sludge feed flow rate. Indicators shall accept 4 to 20 mADC field input and shall be calibrated in gpm.

        d) Green indicating lights for "RUNNING" status for each unit operated from panel, including wash water solenoid valve energized indication.

        e) Red indicating lights for "OFF" status for each unit operated from panel, including wash water solenoid valve de-energized indication.

        f) One each "AUTOMATIC/START" and one "AUTOMATIC/STOP" momentary pushbuttons, for automatically starting and stopping each belt press system. Sludge cake conveyor shall be manually controlled when belt press control mode selector switch is in either the "AUTOMATIC" or "MANUAL" position.

g) One "EMERGENCY STOP" red mushroom pushbutton.

11. Automatic Controls and Sequencing:

    a. General:

    b. Program the PLC for automatic control of belt press, system sequencing, and interlock functions as specified.

    c. Configuration and programming of PLC system shall be responsibility of belt press manufacturer. System documentation including memory loading, 1/0 configuration and progran1mingshall be provided.

    d. Provide and install auxiliary relays and wiring for equipment and devices specified in this Section required for implementing functional requirements specified.

12. " AUTOMATIC START/AUTOMATIC STOP" Cycle:

    a. Automatic start cycle request to PLC shall be initiated by "AUTOMATIC/START " pushbutton.

    b. Control logic for an " AUTOMATIC/START" cycle shall start belt press in the following order after "AUTOMATIC/START" command has been initiated and interlocks are complete.

        a) Wash water pump.

        b) Belt Shower "Pre-Wash"

        c) Belt press drive.

        d) GBT drive.

        e) Feedbox drive.

        f) Polymer system drive.

        g) Sludge feed pump.

    c. Each drive shall not start until previous drive is running and necessary time delay has elapsed. The belt press manufacturer shall determine where time delays are required and shall program settings to provide smooth start-up of equipment.

    d. Once all drives are confirmed running by motor rw1 contacts from their respective starters, PLC shall cause the indicating light to illuminate. Loss of run status contact for a drive once cycle logic is complete shall shut down belt press and associated equipment.

    e. Upon " AUTOMATIC /STOP" command, system shall shut down in order that is reverse of specified start-up order with necessary time delays.

13. Interlocks: The following interlocks shall be satisfied when control mode selector switch is in either "AUTOMATIC" or "MANUAL" position. Failure of any one signal during start cycle

or after cycle is complete shall shut down all associated belt press equipment.

a. Wash water pump must be on and sufficient wash water pressure must be sensed at a specified level.

b. Hydraulic pressure must be sensed at a specified level.

c. Control mode selector switch shall be in "AUTOMATCC" position.

d. " EMERGENCY STOP" pushbutton shall be in operating position.

B. Annunciation and Alarms:

1. Provide audible alarm and detailed alarm history in belt press control panel for alarming of the following:

a. GBT drive failure.

b. Press drive failure.

c. Feedbox drive failure.

d. Local emergency stop initiated at either belt press control panel or pull cord switch.

e. High discharge pressure at sludge feed pump.

f. Low wash-water pressure.

g. Low hydraulic pressure.

h. Polymer pump failure.

i. Sludge pump failure.

2. Wire all alarms to PLC system for relaying to remote location.

3. Additional stations shall be included as hereinafter specified for other ancillary drives or systems.

C. Electric Motors furnished with this equipment shall meet the following requirements:

a. Rated for continuous duty at 40°C ambient and insulated with a minimum of Class F insulation, with Class B temperature rise. All motors shall be totally enclosed, fan cooled or non-ventilated. All motors supplied shall be rated at 150% nameplate horsepower of the required horsepower maximum service condition.

2.5 FLOW METER

A. The belt press manufacturer shall supply one (1) totalizing flow meters as supplied by Siemens or approved equal. One (1) flow meter shall include a 4" ANSI flange connection for the sludge feed line. Each flow meter shall have a digital display, and 30 feet of display cord.

B. The electromagnetic induction flow meter shall generate a voltage linearly proportional to flow for full-scale velocity setting from 2 to 33 feet per second. Standard accuracy of plus output shall be +/- 0.5% of rate for all meters.

C. The meter shall incorporate a high impedance amplifier of 1012 ohms or greater, eliminating the need for electrode cleaning systems the meter shall utilize bipolar pulsed DC coil excitation with

auto-integrated zeroing each half-cycle. Manual zero adjustments shall not be required - even at start-up. Power consumption shall be no more than 15 VA, independent of meter size. Input power required will be from 85 to 120 VAC, 46-65 Hz, with DC input option available.

D. The power to each flow meter is 120 volt, single phase with a 2 amp breaker fed from the belt press control panel.

E. The magnetic flow meter shall be microprocessor based with integral electronics. The electronics shall be interchangeable for all sizes from 1/12" to 78". The housing is to be powder coated cast aluminum with a NEMA 4X rating.

F. The meter' s analog and pulse outputs shall be independently selected by push buttons. The analog output shall be an isolated 4-20mA DC into 700 ohms load. The pulse output shall be an open collector output \With a maximum frequency of 1,000 Hz with configurable pulse width (0.5 to 2 sec). An open collector status output shall indicate either system or process error or flow direction. An auxiliary input shall be available to positive zero return. A low flow cutoff will be standard which can be turned on or off by pushbuttons.

G. A 2-line, 16-digit LCD backlit display shall indicate flow rate and/or total flow. The totalizer value is protected by EEPROM during power outages and utilizes an overflow counter. The display shall also be capable of indicating error messages such as empty pipe condition, error condition and low flow cutoff.

2.6 POLYMER FEED SYSTEM

A. The press manufacturer shall provide as a part of the total dewatering equipment package, two (2) polymer make down system capable of automatically metering, diluting, activating and feeding a liquid polymer with water. The units shall be a BDP model SBM1200-5P-1 unit or engineer pre-approved equal.

1. Manufacturer to provide tubing connecting polymer system to in-line polymer injection ring

2. Polymer system and all components to be powered by master control panel

B. Polymer Make Down Unit

1. Multi-Zone Mixing Chamber

a. Polymer and water shall be mixed in a chamber designed to create sufficient mixing energy. This design shall include a motor driven impeller that will create high fluid sheer. Solution shall undergo a tapered mixing intensity slope as it exits the initial sheer zone and passes through a second zone, isolated by a baffle. Polymer activation efficiency shall be consistent over the dilution water range.

b. Mixing chamber shall be transparent to allow viewing of the mixing intensity

c. Impeller shall be driven by a I HP maximum washdown duty motor. Motor shall be TENV or TEFC. Impeller speed shall be 3450 RPM, minimum. Motor shall be direct-coupled to impeller shaft.

2. Dilution Water Control

    a. Dilution water shall be split into two streams. Primary water flow shall supply the mixing chamber. Secondary water flow shall be used to post dilute the activated polymer strean1. These two streams shall be completely blended by a static mixer prior to exiting the unit.

    b. Unit shall have an electric solenoid valve for on/off control of total dilution water flow.

    c. Flow indicators and flow control valves shall be provided for each dilution water stream.

3. Pump

    a. Unit shall have a neat polymer metering pump. Pump shall be positive displacement, progressive cavity pump.

4. Controls

    a. Unit shall have an on-off-remote, three position switch. In the remote switch position, the unit shall accept a run signal from the belt press control panel. The unit is manually powered in the on position.

    b. Unit shall accept a 4-20mA analog signal to pace the polymer metering pump. This signal shall be from a single tum potentiometer mounted in the belt press control panel (remote), or a local single tum potentiometer.

    c. Unit shall have a dilution water loss of flow sensor which, sensing that water flow has been interrupted for any reason, will place the polymer pump on standby and will restart it automatically when flow is resto red. An integral timer shall monitor loss of flow and energize contracts indicating alarm after 15 seconds of continuous loss.

2.7 SLUDGE FEED PUMP

A. The press manufacturer shall provide as a part of their total dewatering equipment package, two (2) progressive cavity pumps for feeding sludge to the belt presses. The flow capacity of each pump shall be an adjustable range of 30 to 165 GPM at a differential pressure of 50 PSI when operating at a maximum speed of 300 RPM. The pumps shall be sized to handle a minimum 1-5/8" diameter solid.

B. Each pump shall be of the positive displacement, progressive cavity type consisting of a helical rotor, elastic stator, flexible joint and shaft assembly, suction and discharge ports, stuffing box with lantern ring, and drive shaft with bearings and housing. The pumps shall be Netzch, Seepex or approved equal and shall be capable of continuous operation without cavitation or pulsation. It shall be capable of pumping without imparting any turbulence or shearing to the sludge being pumped.

    1. The helical rotor shall be constructed of hard chrome plated stainless steel. The elastic stator shall be vulcanized Buna-N with a minimum Durometer hardness of 65 molded inside the cast iron housing.

    2. A minimum of two (2) cardan type universal joints shall be used to connect the rotor to the

drive shaft. Each joint shall have a minimum of two (2) pins per joint and shall be grease lubricated and sealed in a rubber boot for extended life and lower maintenance.

3. Joints shall be connected to the drive shaft and rotor by means of solid tapered pins and sleeves for maximum torque handling capability. The drive shaft shall be supported by both single and double row heavy duty, grease lubricated ball bearings to withstand all axial and radial loads without affecting component life expectancy.

4. Both suction and discharge ports shall be ANSI 125-pound flanges for maximum resistance to pipe bending forces and deflections. The suction flange shall be 5" diameter, and the discharge flange 4". The suction flange shall be rotatable in 90 degree increments to accommodate any piping configuration or later modification.

5. The pump shall be furnished completely assembled and mounted on a fabricated steel base, with drive assembly.

6. The drive shall consist of a Severe Duty rated TEFC 25 HP gear motor, with an output RPM of 300. The motor shall have Class F insulation. Connection between the motor and pump shaft shall be flexible coupled, Falk or equal. Each gear motor shall be driven by a variable frequency drive, located in the main press panel and shall be of equal construction to the press drive. All control shall be from the press panel.

2.8 DISCHARGE CONVEYOR

A. Dewatered sludge from the belt filter press shall discharge to a U-trough shaftless sludge screw conveyor system as shown on the contract drawings. The conveyor system shall be designed to handle 15% to 25% sludge (dry solids basis) at rates up to 320 cu. ft. per hour. This screw conveyor system shall convey dewatered sludge for direct discharge into the load out container inside the sludge facility as shown on the contract drawings.

   1. Construction of the outside troughs shall be minimum 10 gauge T304SS. End flanges shall be of similar construction with support foot for anchorage. All support members and mounting hardware shall be T304SS. The first conveyor mounted off the ceiling shall be 12” in diameter with the length of +/- 40 ft. The second and third conveyors mounted off of ceiling shall be 12” in diameter with the length of +/- 31 feet – 9 inches.

B. The auger shall be minimum 10-gauge T304SS construction with pitches designed to transport the material referenced above. Support for the auger shall be external 4 bolt flanged ball bearing with end plates specifically designed and sealed for this application or 220 Brinell hardened shaftless spiral..

C. Sludge shall be directed to the conveyor system and splashing prevented through the use of a 14 gauge T304SS hopper and splashguards. Construction shall be welded with interconnections of T304SS hardware.

D. The drive for the horizontal conveyor shall consist of a gearbox and 5 HP 3/60/460V, 50 RPM output constant speed drive (TEFC), rated for continuous service. The drive for the second and third conveyor shall consist of a gearbox and 5 HP 3/60/240V, 50 RPM output constant speed drive (TEFC), rated for continuous service . The gearboxes shall be directly coupled to the auger shaft with gearbox support part of the conveyor support structure.

E. The discharge height of the discharge screw shall be 9 feet 4 inches off the sludge handling room floor. The screw assembly shall be supported by outboard flanged, sealed bearings at each end of the screw assembly. Intermediate hanger bearings shall be by Nylatron with 304 stainless steel mounting brackets placed as required by the manufacturer. The hanger bearings shall be grease-able and shall include Lube Site model 560 automatic lubricator or if shaftless, 3/8" UHMW Liner.

F. All necessary support brackets and stands shall be supplied by the press manufacturer.

G. Each screw conveyor shall be supplied with a zero speed switch.

H. Any belt presses that do not meet the required discharge height as shown on the drawings must be supplied with additional support member to elevate the press to the height shown. All elevated presses must be provided with catwalks around the entire press supplied by the belt press manufacturer. The platforms shall be constructed of 304 stainless steel support members and aluminum non-slip grating. The platforms shall be three feet wide and shall meet all OSHA requirements.

2.9 TOOLS AND SPARE PARTS

A. The following minimum spare parts shall be furnished with the system:

1. Ten (10) spare spray nozzles.

2. Two (2) relays of each type and size.

3. One (1) spare level pressure sensor of each type.

4. One (1) complete set of replacement belts.

5. One (1) complete set of replacement seals.

B. Manufacturer shall furnish a list of additional recommended spare parts for an operating period of one year. The list shall describe each part, the quantity recommended, and the unit price of the part.

C. Spare parts shall be packed in sturdy containers with clear indelible identification markings and shall be stored in a dry, warm location until transferred to the Owner at the conclusion of the Project.

PART 3 EXECUTION

3.0 EXAMINATION

A. Contractor shall off-load equipment at installation site using equipment of sufficient size and design to prevent injury or damage. Pump manufacturer shall provide written instruction for proper handling. Immediately after off-loading, contractor shall inspect complete system and appurtenances for shipping damage or missing parts. Any damage or discrepancy shall be noted in written claim with shipper prior to accepting delivery. Validate all serial numbers and parts lists

with shipping documentation. Notify the manufacturer's representative of any unacceptable conditions noted with shipper.

3.1 INSTALLATION

A. Installation must be in accordance with written instructions supplied by the manufacturer at time of delivery.
B. Fasteners at all pipe connections must be tight. Install and secure all service lines (hydraulic lines, water lines, etc.) as required.

C. Check motor and control data plates for compatibility to site voltage. Install and test the pumps grounds prior to connecting line voltage to station control panel.

D. Prior to applying electrical power to any motors, check all wiring for tight connection. Verify that protective devices (fuses and circuit breakers) conform to project design documents. Manually operate circuit breakers and switches to ensure operation without binding. Open all circuit breakers and disconnects before connecting utility power. Verify line voltage, phase sequence and ground before actual start-up.

E. Pumps and motors shall be installed in accordance with manufacturer's installation instructions, and in accordance with all OSHA, local, state, and federal codes and regulations.

F. The manufacturer shall provide the services of a qualified factory representative to advise the installing manufacturers on proper installation, setting, piping, and wiring procedures. This time shall be above and beyond the start-up services described below.

3.2 INSPECTION

A. A factory qualified service representative shall be present at initial startup of the system to ensure correct installation and rotation of the unit, supervise a review of the operation and testing of the equipment, and to provide training on operation and maintenance requirements of the equipment. Any deficiencies shall be noted and corrected prior to the commissioning of the system.

B. Manufacturer's inspection shall include, but not be limited to, the following parameters as applicable:

1. Soundness

2. Completeness in all details, as specified,

3. Correctness of setting, alignment and relative arrangement of various parts; and

4. Adequacy and correctness of sealing and lubricants.

3.3 FIELD QUALITY CONTROL

A. Operational Test

1. Prior to acceptance by owner, an operational test of all pumps, drives, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified operating characteristics.

2. After construction, in the presence of the Engineer and Operator, the contractor shall operate the system through several pumping cycles and shall observe and record operation of components; check calibration of all instrumentation equipment, test manual control devices, and automatic control systems. Be alert to any undue noise, vibration or other operational problems.

B. Manufacturer's Start-up Services

1. Before the equipment is started, the manufacturer shall make a thorough inspection of the installation to make sure the press has been installed properly and that all equipment relating to it has been installed according to the needs of the press.

2. The manufacturer shall provide nine (9) days of on-site services spread over three trips of a qualified factory representative to place the units in operation. The owner shall assist the manufacturer by starting up and operating all support systems such as water, sludge pumping, polymer mixing and feed, electrical power and instrumentation, and other ancillary equipment as needed. This trip will be separate from training and performance. The services provided by the manufacturer shall be as detailed in the O&M manuals and shall include at a minimum the following:

    a. Check equipment alignment and assure that there are no unusual internal stresses.

    b. Calibrate all instrumentation such as hydraulic systems.

    c. Check hydraulic systems to insure proper operation.

    d. Check lubrication in all drives.

    e. Adjust all edge seals, discharge scraper blades, drive chains, etc.

    f. Adjust spray wash, cloth tension, and belt aligning system.

    g. Start the drives and assure they are operating properly with no binding and with correct rotation.

    h. Ensure that all ancillary systems have been properly adjusted, including polymer and sludge feed.

3. Start-up services shall be considered completed when the contractor and manufacturer have demonstrated to the owner that the units are operating without mechanical problems.

C. Training supervision

1. During the start-up procedures, the equipment manufacturer shall provide two separate trips, five days of on-site training to the owner's employees for proper operation and maintenance

of the sludge dewatering equipment.

2. Two (2) emergency service trips with one day of on-site service for each trip.

3.4 TESTING

A. In the presence of the Engineer and the Operator, field testing of all equipment shall be performed to determine that operation is satisfactory and in compliance with the specifications. Testing shall be completed after the installation is complete, the equipment has been operated and all necessary adjustments have been made. Testing shall be completed using aerobically digested sludge produced from the aerobic digesters after the installation of the aerobic digesters and belt press system is complete.

B. During the field tests, as a minimum, the following items shall be recorded:

1. Sludge flow rate (gpm)

2. Polymer dosage (act. lb/dry ton)

3. Discharge cake solids (%wt)

4. Minimum solids capture (%)

C. Testing shall meet performance criteria listed in Section 1.3 of this specification before final acceptance by engineer and owner.

D. A written report shall be supplied to the engineer upon completion. Repeat tests if necessary, to obtain results acceptable to engineer.

E. The Contractor shall take corrective action to ensure full compliance to meet performance criteria.

END OF SECTION 467621