END OF TABLE OF CONTENTS

ABBREVIATIONS:
Schemtic Design Phase: SD
Design Developemt Phase: DD
Construction Development: CD
Draft For Review: DFR
For Pricing: PRI
For Permiting: PMT
For Bidding: BID
For Construction: CON

Show accurate field dimensions and clearly note field conditions. identify materials and products in the work shown. Note special coordination required.

1. PDF files: Contractor shall submit copies of portable document format files for review. At his discretion, the Architect may request hardcopy as per paragraph 2 below.
2. Submittal Quantities: Submit at least 1 scannable copy and digitial copy and, if requested, three blackline prints of Shop Drawing submittals.
3. After Architect's action, follow specified distribution procedure.

F. Samples: Provide units identical with final materials and products to be installed in the work. Where indicated, prepare samples to match Architect's sample. Label each sample with description, source, generic name or manufacturer's name and model number. Architect will review samples for confirmation of visual design intent, color, pattern, texture and type only; Architect will not test samples for compliance with quality and other Contract requirements which shall remain the exclusive responsibility of the Contractor.

1. Initial Selection Samples Submittal Quantities: Unless a specific, unique product is specified, for initial selection purposes, submit a set of samples showing the complete range of colors and finishes available, as follows:
   For exterior assemblies: One for Owner, one for architect, and required quantity for contractor.
   For interior assemblies: One for Owner, one for architect, one for interior designer, if any, and required quantity for contractor.
2. Verification Samples Submittal Quantities: For verification of an initial selection, submit 3 sets of samples; one set will be returned to Contractor to be maintained at project site for quality control comparisons.

G. Timing of Submittals: Submit submittals in a timely fashion to allow at least 10 business days for each office's review and handling. The Architect and their consultants make no commitments as to the duration of review of submittals. This is a condition of the work and Contractors agree that delay claims are exempt from shop drawing review time. This means that submittals which have to be reviewed by the Architect and one of his consultants require at least 20 business days for review and handling. Add ten business days for each additional consultant who must review a submission.

H. Architect's Action on Submittals: Architect will review submittals, stamp with "action stamp", mark action, and return to Contractor. Architect will review submittals only for conformance with the design concept of the project. The Contractor is responsible for confirming compliance with other Contract requirements, including without limitation, performance requirements, field dimensions, fabrication methods, means, methods, techniques, sequences and procedures of construction, coordination with other work. The Architect's review and approval of submittals shall be held to the limitations stated in the Owner/Architect Agreement and the Conditions of the Contract.. In no case shall approval or acceptance by the Architect be interpreted as a release of Contractor of his responsibilities to fulfill all of the requirements of the Contract Documents.

1. Required Re-submittal: Comply with indications on Transmittal and Stamp.
2. Distribution: When submittal is reviewed and resubmittal is not required, make prints or copies and distribute to Owner, Subcontractors involved, and to all other parties requiring information from the submittal for performance or coordination of related work. Print shop drawings for distribution only from the final reviewed drawings showing all notations and comments.
3. Submittals which deviate from the Contract Documents will not be allowed.
4. Submittals which deviate from the Contract Documents and have not been submitted by the standard substitution process and have not been highlighted as a deviation, shall be considered unacceptable for incorporation into the work whether or not they have been approved by the Architect. In other words, undocumented deviations are not approved regardless of any other action by the Architect.

I. Mock-ups – General: Provide mock-ups where specified in individual sections or shown on drawings.

J. Mock-ups – Type 1: Shall be disposable and not considered “In-Place Sample Mock-ups” are required unless otherwise indicated. All mock-ups shall be type 2 below, unless otherwise noted. Purpose and requirements are as follows:

SECTION 01 00 00 - CONSOLIDATED GENERAL REQUIREMENTS

SECTION TABLE OF CONTENTS

PART 1 - GENERAL

1.1. RELATED DOCUMENTS

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. This Section applies to all Work performed under the Contract.

C. Comply with the special requirements of Owner.

D. This project shall be built under the provisions of Section 135 of New York State Finance Law, aka, “Wicks Law”; this project shall be consist of multiple prime bids for each of the respective trades required. The requirements of Division 01 and the General Conditions shall apply severally and equally to each of the multiple prime bidders, who shall be solely responsible for fulfilling those requirements for their part of the Work. Unless otherwise indicated by the bid requirements and herein, the four prime bidders [aka, trades] shall consist of:
   1. Construction Contract or Trade Contractor.
   2. HVAC [aka Heating Ventilation & Air Conditioning] Contract or Trade Contractor.
   3. Plumbing Contract or Trade Contractor.
   4. Electrical Contract or Trade Contractor.

E. For the purposes of this project, the term “Contractor” when used in Divisions 02 through 14, shall refer to the Construction Contract or Trade Contractor noted in 1.1.D.1 above.

F. There will be four prime contracts on this project, as stated above. The contracts are awarded and administered by the County, who is not only the Owner and the Construction Manager, but also acts to coordinate all trades on the project.

G. Unless otherwise noted in the bidding requirements, agreement forms and conditions of the contract, the following shall apply to the Work of the multiple prime contractors.
   1. Cutting and patching and core drilling shall be performed by the trade requiring such to perform their work. The same requirement applies to hangers, clips and sleeves.

2. Allowances, if any, shall apply equally to all contracts, unless applied in the allowance to one contractor.
3. The following apply equally to all prime contractors /trades:
   a. Submittals.
   b. Coordination drawings.
   c. Construction facilities and temporary controls, except as noted below.
   d. Field offices for the use of the Trade in question, ie, each pays for their own.
   e. Progress cleaning and rubbish removal.
4. The following shall be paid for or performed by the Contraction Trade:
   a. Existing building demolition.
   b. Building construction and sitework.
   c. Field engineering.
   d. Fuel for temporary heat and responsibility for damage due to frost or freezing or degradation of installed work due to lack of adequate temporary heat.
   e. Cost of electrical power usage.
   f. Temporary Water Service and Maintenance.
   g. Temporary toilets.
   h. Cost of temporary power.
   i. Temporary material and personnel hoists. The Construction Trade shall assign a percentage of use for each trade and be responsible to prevent conflicts in scheduling or sequencing of construction.
   j. Temporary exterior wall opening enclosures and temporary partitions.
   k. Temporary fence enclosures.
   l. Temporary roads, parking and staging area construction and maintenance.
   m. Snow removal.
   n. Dewatering and site water management.
5. The following shall be paid for by the Plumbing Trade:
   a. Any required temporary fire protection, including temporary standpipes.
6. The following shall be paid for by the Electrical Trade:
   a. Any required temporary light and power service supply and wiring.

1.2. SUMMARY OF WORK & PROJECT REQUIREMENTS

A. Project Identification: As listed on cover page and in header.

B. The work consists of: . New construction.
   1. All MEP trades; indicated site, civil and landscape work in compliance with Wicks Law.
   2. Demolition
   3. A separate FF&E contract entered into by the Owner to provide furniture and/or equipment, except as otherwise noted on the drawings.
   4. Coordination with the vendors, suppliers and installers of this Contract.

C. Comply with the Owner Standards. Specific attention is directed to:

   1. Written reports to be provided detailing subcontractors at the site, and Contractor's workers and, weather conditions, description of work done, deliveries, Owner/Architect instructions and decisions. Deliver report to Owner ce the next following working day before noon.

   2. Requirements for regular project meetings, at intervals required by Owner or Architect.

   3. Construction Scheduling.

   4. Work hours, which are typically 7:00 to 3:00 unless otherwise arranged and approved in writing by Owner.

   5. Comply with requirements for permits, details, fire watch and shut downs. Note that additional fees for accelerated construction and off hours work and scheduling of work during on holidays or other times will not be permitted regardless of the fact that authorities having jurisdiction may prohibit work at certain hours or on certain days.

   6. Management of fire detectors and coordination with Fire Marshalls in locality having jurisdiction.

7. Parking arrangements.
8. The requirement for progress photos.
9. Punch list.
10. The Owner's right to occupy and place equipment in completed areas of the building prior to Substantial Completion which does not interfere with the completion of the Work.
11. Construction Management software: Where required by Owner or Architect, it is a contract requirement that software compatible with Architect/Owner systems be used during all construction phases. This included management and scheduling software.
12. Owner Tax Exempt Status: Comply with the requirements of state statutes for payment of state taxes in connection with construction projects performed for tax exempt entities. Verify Owner status and requirements for payment to sales tax.

D. Sustainable Design Intent: The Project is intended to be of sustainable or "green" design, and as a result thefollowing requirements are made a part of the Contract Requirements for this Project:

1. Compliance with Institution/Local/State/Agency sustainability requirements and regulations and applicable building code standards.
2. Take notice of Section 01 57 10, Construction Waste Management. See other sections and specific requirements throughout the contract.
3. At interior locations, provide low-emitting (low VOC) adhesives, sealants, paints, coatings, carpet systems, systems furniture, and seating
4. At interior locations, provide composite woods, agrifiber products, and laminate adhesives with no added urea-formaldehydes.
5. Provide green housekeeping methods at final closeout.
6. Owner certification goal: Review with Owner.
7. The Contractor is responsible for a significant portion of the prerequisites and credits necessary to obtain the necessary certification, and these requirements are included in the Contract.
8. Comply with Owner recycling goal for demolition and construction waste removed from the site.

E. Project Requirements for Temporary Utilities and Facilities:

1. Utility Costs: The Contractor shall meter and pay for cost of utility services consumed, including electricity, water, gas and temporary heat, in manner indicated above.
2. Temporary Offices: Provide field offices.
3. Toilet Facilities: Provide toilet facilities for construction personnel.

F. Permits and Fees: Apply for, obtain, and pay for permits, fees, and utility company backcharges required to perform the work. Submit copies to Architect and Owner immediately upon receipt.

G. Dimensions: Verify dimensions indicated on drawings with field dimensions before fabrication or ordering of materials. Do not scale drawings.

H. Existing Conditions: Notify Architect of existing conditions differing from those indicated on the drawings. Do not proceed with work that requires deviation from the design with Architect's written approval.

I. Contractor's Conduct on Premises: The Contractor and his employees shall behave in a respectful, courteous and safe manner. Abusive, harassing, and lewd behavior is prohibited. Music playing is prohibited. Alcohol, tobacco and drug use is prohibited.

J. Hazardous Waste: Refer to Owner. Hazardous waste is outside the scope of responsibility of the Architect and his consultants.

K. Contractor's Management Staff Requirements: Provide staff necessary to manage project and acceptable to Owner.

1. Experience, Qualifications: Minimum 3 years experience with projects similar to this Contract.

2. Reassignment or Replacement: If requested by the Owner or Architect at any time during the Contract, replace Contractor's management staff with personnel acceptable to the Owner and Architect. Do not reassign or replace management staff, unless preapproved by the Owner.
3. On Site: Contractor's Management Staff shall be on site whenever work is in progress.
4. Work Restrictions: Contractor's Management Staff shall manage, supervise, coordinate, plan, and direct the work.
5. Installation/MEP Coordinator: Provide the services of an experienced installation coordinator.

L. Restrictions on Noise: Comply with requirements of authorities having jurisdiction.
1. Use equipment with well maintained mufflers.
2. Use the least noisy techniques practical.
3. Schedule noisy activities when ambient background noise level is highest.
4. Turn off all unneeded and idling equipment and engines.
5. Locate noise sources as far as practical from noise sensitive locations.
6. Orient noise sources away from noise sensitive locations

1.3. SPECIFICATION INFORMATION

A. Refer to Owner contract language.

1.4. DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Accepted": When used to convey Architect's action on Contractor's submittals, applications, and requests, "Accepted" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. . Other terms including "requested," "authorized," "selected," "approved," "accepted," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, disposing of packaging, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": Furnish and install, complete, in place, and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

J. "As shown, if not": As shown or indicated in the Contract Documents and if not so shown, then provide the item(s) following "if not,".

K. "Section includes": unless otherwise noted, shall mean, "Section includes, without limitation, providing".

L. "As indicated" or "As shown" or "As scheduled" shall mean as indicated on the drawings or finish schedule or finish legend.

M. "Contractor": Shall refer to either just one or any and all multiple prime contractors, as required by the sense of the language in the specifications. In the event of lack of clarity, refer to the Owner during the bidding period for any required clarifications.

1.5. INDUSTRY STANDARDS

A. Referenced standards are part of the Contract Documents and have the same force and effect as if bound with these specifications.

B. Except where specifically indicated otherwise, comply with the current standard in effect as of the date of the Owner/Contractor Agreement. Obtain copies of industry standards directly from publisher.

C. The titles of industry standard organizations are commonly abbreviated; full titles may be found in Encyclopedia of Associations or consult Architect.

1.6. CODES AND REGULATIONS

A. Comply with all applicable codes, ordinances, regulations and requirements of authorities having jurisdiction:

B. Submit copies of all permits, licenses, certifications, inspection reports, releases, notices, judgments, and communications from authorities having jurisdiction to the Owner.

1.7. PROGRESS SCHEDULE

A. Provide comprehensive bar chart schedule showing all major and critical minor portions of the work, sequence of work and duration of each activity. Update and reissue regularly, but not less than monthly. Comply with the following:

B. Contract Progress Schedules and Reports: Provide Critical Path Method [CPM] progress schedules and reports.
1. Software Program: Subject to approval by Owner and Architect.
2. First Submittal: Within 30 days after executed Owner Contractor Agreement.
3. Updated Submittals: Required at least once per month.
4. Subcontractors: Shall provide information requested by the General Contractor.
5. Contract Progress Schedule and Schedule of Values: Make the Contract Progress Schedule work items with the Schedule of Value work items the same.

C. Contract Progress Schedule Content: Include at least the following information.
1. All major and critical minor Contract activities.
2. Sequence and duration of each activity.
3. Project milestones.
4. Early start and early finish for each activity.
5. Late start and late finish for each activity.
6. Total float time for each activity.
7. Submittals related to each activity including dates of first submittal and last date for approval.
8. Fabrication and delivery time for each item requiring off site fabrication.
9. Start and completion dates for each mock up and sample including in place samples.
10. The critical path of work.

D. Contract Progress Schedule Reports: Submit reports including at least the following information:
1. The critical path of work and all work items on the critical path.
2. Bar chart plot.
3. Plot showing the content specified above.
4. Monthly activity plots for each month.
5. Two week “look ahead” plots.
6. “Executive Summary” indicating if on schedule or, if not on schedule, problem areas.

E. Contract Progress Schedule Updates: Update at least once per month, and as follows:
1. Unless otherwise agreed, submit with Application for Payment.
2. Incorporate actual start and complete dates.
3. Update whenever the Contract Time is revised by Change Order.

F. Recovery Plan: Prepare and submit a “Recovery Plan” whenever the work is 10 calendar days or more behind schedule. Show how the project will be managed back to “on schedule” condition.

1.8. PROCEDURES AND CONTROLS

A. Project Meetings: The Owner shall arrange for and attend project meetings with the Architect and Prime Contractors and such other persons as the Owner requests to have present. The Primer Contractos shall be represented by a principal, project manager, general superintendent or other authorized main office representative, as well as by the Prime Contractors' field superintendent. An authorized representative of any subcontractor or sub-subcontractor shall attend such meetings if the representative's presence is requested by the Owner. Such representatives shall be empowered to make binding commitments on all matters to be discussed at such meetings, including costs, payments, change orders, time schedules and manpower. Any notices required under the Contract may be served on such representatives. Written reports of meeting minutes shall be prepared and distributed to attendees, the Architect, Prime Contractor(s), and Owner in advance of the next meeting by the person[s] designated by the Owner to prepare same.

1. Pre-Construction Conference: Attendance by Architect [if requested by Owner], Prime Contractors, major subcontractors. Agenda shall include: Quality of workmanship, coordination, interpretations, job schedule, submittals, approvals, requisition procedures, testing, protection of construction, indoor air quality, and construction waste management.

B. Emergency Addresses: Furnish the Owner and Architect, in writing, the names addresses and telephone numbers of individuals to be contacted in the event of an out-of-hours emergency at the building site. Post a similar list readily visible from the outside of the field office or a location acceptable to the Architect.

C. Layout: Layout work and be responsible for all lines, elevations, and measurements of the work executed under the contract. Where required to complete the work properly, the Contractor shall engage and pay for a professional land surveyor.

D. Field Measurements: Verify measurements at the building prior to ordering materials or commencing work. No extra charge or compensation will be allowed because of differences between actual dimensions and measurements indicated on the Drawings. Differences which may be found shall be submitted to the Architect for decision before proceeding with the work.

E. Field Measurements for Fixed Equipment: Dimensions for fixed equipment to be supplied under this Contract or separate contracts shall be determined by field measurements taken jointly by the Contractor and the equipment supplier involved. A record of the field measurements shall be kept until time of substantial completion of the project, or until the equipment has been fully installed and accepted by the Owner, whichever is later. Responsibility for fixed equipment fabricated accurately to field measurements for proper fit and operation shall be that of the Contractor. Contractor shall pay all costs involved in correcting any mis-fitting fixed equipment as fabricated.

F. Project Limit Line: The boundaries of the site do not limit the responsibility of the Contractor to perform the work in its entirety. Make utility connections as indicated.

G. Matching: Where matching is indicated, the Architect & Owner shall be the sole and final judge of what is an acceptable match. Mockups and sample submissions are required.

H. Observation: Notify the Architect and authorities having jurisdiction at least thirty-six hours in advance of concealing any work.

I. Utilities: Prior to interrupting utilities, services or facilities, notify the utility owner and the Owner and obtain their written approval a minimum 48 hours in advance, but 72 hours is preferred.

J. Furnishings, Fixtures, and Equipment: Cooperate and permit the Owner to install his furnished items. Installation of such furnishings or equipment does not signify Owner's acceptance of any portion of the work.

K. Clean-Up: Frequently clean-up all waste, remove from site regularly, and legally dispose of off-site.

L. Installer's Acceptance of Conditions: All installers shall inspect substrates and conditions under which work is to be executed and shall report in writing to the Contractor all conditions detrimental to the proper execution and completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning work means installer accepts previous work and conditions.

M. Coordination: Under the direction of the Owner, the Prime Contractors shall be jointly, severally and individually shall be fully responsible for coordinating the work under their particular contract of all trades, coordinating construction sequences and schedules, and coordinating the actual installed location and interface of all work.

1. Prior to beginning mechanical, electrical and fire protection work, the respective Mechanical and Electrical Prime Contractors shall prepare coordination drawings electronically showing the exact alignment, physical location and configuration of the mechanical, electrical and fire protection installations and demonstrating to the Contractor's satisfaction that the installations will clear all obstructions, permit proper clearances for the Work of other trades, and present an orderly appearance where exposed. The respective Prime Contractors shall be solely liable and responsible for any costs and delays resulting from the Prime Contractors' failure to prepare any such coordination drawings or from the negligent preparation of such coordination drawings. At the completion of the work turn over all coordination drawings to the Architect and Owner. Provide drawings as follows:
   a. Scale: ¼ inch = 1'-0" or larger scale.
   b. Color: Color code each trade in a clearly different color.
   c. Conflicts: Indicate all conflicts by means of a clear symbol and note.

2. Exact locations and groupings of mechanical, electrical and fire protection fixtures, switches, heads, devices and outlets shall be obtained from the Architect before the Work is roughed in, if not already indicated. Work installed without such information from the Architect shall be relocated at the respective Prime Contractors' expense if the Architect so requests.

N. Request For Interpretation (RFIs):

1. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and prepare and submit an RFI in the form specified.
   a. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
   b. Submit RFI electronically unless otherwise agreed.
2. Content of the RFI: Include a detailed, legible description of item needing interpretation.
3. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow 5 working days for Architect's response for each RFI and 7 where Architect's consultants are involved. RFIs received after 1:00 p.m. will be considered as received the following working day.
4. The following RFIs will be returned without action:
   a. Requests for approval of submittals.
   b. Requests for approval of substitutions.
   c. Requests for coordination information already indicated in the Contract Documents.
   d. Requests for adjustments in the Contract Time or the Contract Sum.
   e. Requests for interpretation of Architect's actions on submittals.
   f. Incomplete RFIs or RFIs with numerous errors.

O. Existing Articles of Unusual Value: If during demolition, excavation, or disposal work articles of unusual value or of historical or archaeological significance are encountered, the ownership of such articles is retained by the Owner, and information regarding their discovery shall be immediately furnished to the Architect. If the nature of the article is such that work cannot proceed without danger of damage, work in the area shall be immediately discontinued until the Architect has determined the proper procedure to be followed. Delays in time thereby shall be a condition for which the time of the Contract may be extended. Costs incurred after discovery in the salvaging of such articles shall be borne by the Owner.

P. Quality Control & Testing Services: Coordinate with the Owner and Architect in the event testing is required. Provide services necessary to enable inspectors, testing laboratory representatives and the like to perform their work.

Q. Progress Photos: Refer to General Contract language.

R. Daily Reports: Provide daily reports and submit to Owner and Architect once per week.

S. Long Lead Time Items: Time is of the essence in the Contract. Expedite and provide special management for "long lead time" items.

T. Contractor's Responsibilities Related To The Owner's Management Staff:
1. Cooperate with the Owner's management staff.
2. Provide "Weekly Work Plan" each Monday morning by 8:00 am.
3. Provide immediate notification of all unusual conditions and occurrences at the site.
4. Identify all persons at the site, both workers and visitors.

U. Documents On Site: Maintain the following documents on site and up-to-date:
1. Contract Documents.
2. Modifications and changes to Contract Documents.
3. Coordination drawings.
4. Meeting notes for all types of meetings: progress, safety, preinstallation, special, and others.
5. Progress schedules and related information.
6. Project photographs.
7. Daily reports.
8. Submittal log and all submittals.

1.9. SUBMITTALS

A. Form of Submittal: Use Architect's electronic system unless otherwise directed in writing. Comply with Architect's formatting and tel/data requirements. Where the Architect does not use a dedicated ftp site or server, submit documentation via scanned documents and email. Comply with required transmittal and data formats using numbering system approved by Architect.

Required Submittals: Submit shop drawings, product data, initial selection samples, verification samples, calculations, coordination drawings, schedules, and all other submittals as specified in individual specification sections.
1. Provide submittals for cleaning and maintenance products to be used during construction and final cleaning.

B. Submittal Schedule: Within 30 days after award of contract and before first application for payment, prepare list of submittals in chronological sequence showing all submittals and proposed date first due at Architects office and proposed date due to be returned to Contractor. Note relevant specification section number.

C. Contractor's Preparation of Submittals: Modify and customize all submittals to show interface with adjacent work and attachment to building. Identify each submittal with name of project, date, Contractor's name, subcontractor's name, manufacturer's name, submittal name, relevant specification section numbers, and Submittal Schedule reference number. Stamp and sign each submittal to show the Contractor's review and approval of each submittal before delivery to Architect's office; unstamped and unsigned submittals will be returned without action by the Architect. Leave 4" x 6" open space for Architect's "action" stamp.

D. Product Data: Provide manufacturer's preprinted literature including, without limitation, manufacturer's standard printed description of product, materials and construction, recommendations for application and use, certification of compliance with standards, instructions for installation, and special coordination requirements. Collect data into one submittal for each unit of work or system; mark each copy to show which choices and options are applicable to project
1. Options: All required or available options shall be indicated and noted by the Contractor.
2. Submittal Quantities: Unless otherwise requested, provide only electronic format. If hardcopy is requested, submit at least 1 reproducible copy and three additional copies.
3. Installer Copy: Verify that the Installer has a current copy of the relevant product data, including installation instructions, before permitting installation to begin.

E. Shop Drawings: Provide accurately prepared, large scale and detailed shop drawings prepared specifically for this project on scannable or reproducible sheets or via online. Show adjacent conditions and related work.

1. To permit Owner and Architect to review and approve assemblies prior to ordering and to be used as sample of acceptable work.
2. Construct mock-ups as early as possible and before ordering products.
3. Provide actual materials indicated.
4. Locate mock-ups as directed by architect.
5. Develop and prepare mock-up construction drawings.
6. Protect mock-ups until no longer needed by Owner and Architect.
7. Demolish, remove and dispose of mock-ups as directed.
8. Provide indicated mock-ups.

K. Mock-ups – Type 2 : Provide mock-ups indicated in specifications sections which unless otherwise indicated may be left in place if approved after review. Applicable requirements of Type 1 apply to this type of mock-up. All mock-ups shall be type 2 unless otherwise noted.

I. Sustainable Construction Submittals : Comply with Sustainable Design specifications and requirements, including local municipality regulations and provisions.

J. Maintain all necessary records in current form throughout the execution of the Work.

M. The Architect's general approval of a submittal is not intended to modify or waive any requirements of the drawings and specifications. If a submittal proposes to modify materials, size, assembly, quality or appearance as required by the drawings and specifications, said proposed modification will be clearly and boldly marked upon the submittal. Absent Architect's explicit approval of this boldly marked modification, said proposed modification shall not be deemed approved.

1.10. WARRANTIES

A. Warranties Required: Refer to individual trade sections for specific product warranty requirements.

B. Procurement: Where a warranty is required, do not purchase or subcontract for materials or work until it has been determined that parties required to countersign warranties are willing to do so.

C. Warranty Forms: Submit written warranty to Owner through Architect for approval prior to execution. Furnish two copies of executed warranty to Owner for his records; furnish two additional conformed copies where required for maintenance manual

D. Work Covered: Contractor shall remove and replace other work of project which has been damaged as a result of failure of warranteed work or equipment, or which must be removed and replaced to provide access to work under warranty. Unless otherwise specified, warranty shall cover full cost of replacement or repair, and shall not be pro-rated on basis of useful service life.

E. Warranty Extensions: Work repaired or replaced under warranty shall be warranted until the original warranty expiration date or for ninety days whichever is later in time.

F. Warranty Effective Starting Date: Guarantee period for all work, material and equipment shall begin on the date of substantial completion, not when subcontractor has completed his work nor when equipment is turned on. In addition to the one year guarantees for the entire work covered by these Contract Documents, refer to the various sections of the specifications for extended guarantee or maintenance requirements for various material and equipment.

1.11. CUTTING AND PATCHING

A. Limitations: Do not cut and patch any work in a manner that would result in a failure of the work to perform as intended, decreased energy performance, increased maintenance, decreased operational life, or decreased safety.

1. Structural Work: Do not cut structural work or bearing walls without written approval from Architect. Where cutting and patching of structural work is necessary and approved by Architect, perform work in a manner which will not diminish structural capacity nor increase deflection of member. Provide temporary shoring and bracing as necessary. Ensure the safety of people and property at all times.

B. Cutting and Patching Materials: Use materials identical to materials to be cut and patched. If identical materials are not available or cannot be used, use materials that match existing materials to the greatest extent possible. Provide finished work that will result in equal to or better than existing performance characteristics.

C. Inspection: Before cutting and patching, examine surfaces and conditions under which work is to be performed and correct unsafe and unsatisfactory conditions prior to proceeding.

D. Protection: Protect adjacent work from damage. Protect the work from adverse conditions.

E. Cutting: Cut work using methods least likely to damage adjoining work. Use tools designed for sawing or grinding, not hammering or chopping. Use saws or drills to ensure neat, accurately formed holes to sizes required with minimum disturbance to adjacent work. Temporarily cover openings ; maintain weather-tightness and safety.
   1. Utilities: Locate utilities before cutting. Provide temporary utilities as needed. Cap, valve, or plug and seal ends of abandoned utilities to prevent entrance of moisture or other foreign matter.

F. Patching: Patch with seams and joints which are durable and not visible. Comply with specified tolerances for similar new work; create true even planes with uniform continuous appearance. Restore finishes of patched areas and, if necessary, extend finish restoration onto adjoining unpatched area to eliminate evidence of patching and refinishing. Repaint entire assemblies, not just patched area. Remove and replace work which has been cut and patched in a visually unsatisfactory manner as determined by the Architect.

E. Qualifications: Retain experienced and specialized firms, original installers if possible, to perform cutting and patching. Workmen shall be skilled in type of cutting and patching required.

F. Cutting and patching includes coring and core drilling. Cutting and patching not performed by trades shall be performed by the (General) Contractor.

1.12. FIELD ENGINEERING

A. Provide required field engineering including property metes, bounds and elevation surveying of both land and structures, civil engineering services and structural engineering services.

B. Field engineering submittals include:
   1. Certificates signed by the Land Surveyor or Professional Engineer certifying that the location, layout and elevation of improvements comply with the Contract Documents.
   2. Final Property Survey: Where the contract documents or the regulation of the municipality have jurisdiction require survey drawings, submit one copy for the Owner, one for the Architect and however many are required by the municipality..
   3. Project Record Documents: Submit a record of Work performed and record survey data as required under provisions of Sections "Submittals" and "Project Closeout".

C. Quality Assurance: Engage a Registered Land Surveyor registered or where required, a professional engineer in the State where the project is located, to perform land surveying services required.

D. Surveys & Control Points: Upon request, the Owner will identify existing control points and property line of which he is aware, and when available, will provide copies of site surveys. Where property surveys are not included in the contract documents, generate the needed property survey information as part of the work of this contract.

E. Verify layout information shown on the Drawings, in relation to the property survey and existing benchmarks before proceeding to layout the Work. Locate and protect existing benchmarks and control points. Preserve permanent reference points during construction.

1. Do not change or relocate benchmarks or control points without prior written approval. Promptly report lost or destroyed reference points, or requirements to relocate reference points because of necessary changes in grades or locations.
2. Promptly replace lost or destroyed project control points. Base replacements on the original survey control points.

F. Establish and maintain a minimum of two permanent benchmarks on the site, referenced to data established by survey control points.

G. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.

H. Existing utilities and equipment: 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 and other construction.

I. Prior to construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, water service piping, and other underground utilities affected by the work.

J. Performance: Working from lines and levels established by the property survey, establish benchmarks and markers to set lines and levels at each story of construction and elsewhere as needed to properly locate each element of the Project. Calculate and measure required dimensions within indicated or recognized tolerances. Do not scale Drawings to determine dimensions.

K. Advise entities engaged in construction activities, of marked lines and levels provided for their use.

L. As construction proceeds, check every major element for line, level and plumb.

M. Surveyor's Log: Maintain a surveyor's log of control and other survey Work. Make this log available for reference.

N. Record deviations from required lines and levels, and advise the Architect when deviations that exceed indicated or recognized tolerances are detected. On Project Record Drawings, record deviations that are accepted and not corrected.

O. 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.

P. Site Improvements: Locate and lay out site improvements, including pavements, stakes for grading, fill and topsoil placement, utility slopes and invert elevations by instrumentation and similar appropriate means.

Q. Building Lines and Levels: Locate and lay out batter boards for structures, building foundations, column grids and locations, floor levels and control lines and levels required for mechanical and electrical Work.

R. Existing Utilities: Furnish information necessary to adjust, move or relocate existing structures, utility poles, lines, services or other appurtenances located in, or affected by construction. Coordinate with local authorities having jurisdiction.

S. Final Property Survey: Before Substantial Completion, prepare a final property survey showing significant features (real property) for the Project. Include on the survey a certification, signed by the Surveyor, to the effect that principal metes, bounds, lines and levels of the Project are accurately positioned as shown on the survey.

T. Recording: At Substantial Completion, have the final property survey recorded by or with local governing authorities as the official "property survey".

1.13. TEMPORARY FACILITIES AND UTILITIES

A. Scope of Temporary Work: This article is not intended to limit the scope of temporary work required under the Contract. Provide all temporary facilities and utilities needed and to maintain on-going building operations in the case of existing facilities.

B. Permits and Fees: Obtain and pay for all permits, fees and charges related to temporary work.

C. Codes and Authorities Having Jurisdiction for Temporary Facilities and Utilities: Comply with all requirements of authorities having jurisdiction, codes, utility companies, OSHA, and industry standards including, but not limited to the following:

1. NFPA Code 241, Building Construction and Demolition Operations.
2. ANSI-A10 Series, Safety Requirements for Construction and Demolition.
3. NECA National Joint Guideline NJG-6, Temporary Job Utilities and Services.
4. Electrical Service: NEMA, NECA, and UL.

D. Field Offices: Provide Contractor's field offices as needed. Keep current copies of all Contract Documents and project paperwork neatly on file at jobsite. Permit Architect's unrestricted use of Contractor's field office facilities including copiers, telephones, plan tables, and other equipment. Furnish, maintain, and pay for light, power, phone, fax, and other field office services.

E. Equipment and Tools: Provide all equipment including, but not limited to, hoists, lifts, scaffolding, machines, tools and the like, as needed for execution of the work. Provide safe access to all parts of the work.

F. Temporary Enclosures: Provide temporary enclosures to maintain proper temperatures and in no case less than 50 degrees F once temperature or humidity sensitive components are in place and to prevent weather damage, pollutions, dust or excessive noise. Always maintain legal means of egress. Comply with the provisions of “Weather Protection” given below.

G. For cold weather climates only, Snow and Ice: Remove all snow and ice which interferes with work or safety.

H. Streets, Walks and Grounds: Maintain public and private roads and walks clear of debris caused by construction operations. Repair all damage caused to streets, drives, curbs, sidewalks, fences, poles and similar items where disturbed or damaged by building construction and leave them in as good condition after completion of the work as before operations started.

I. Protection: Protect nearby property and the public from construction activities. provide and maintain barricades, warning signs and lights, railings, walkways and similar items. Immediately repair damaged property to its condition before being damaged.

J. Security: Secure site against unauthorized entry at all times. Provide secure, locked temporary enclosures. Protect the work at all times. Provide watchman service, if necessary, to protect the work.

K. Signs: Erect project identification signs in compliance with details to be provided by Architect. Signs shall be minimum 4' x 8' exterior grade plywood and shall contain the names of the project, Owner, Architect, major Consultants, Contractor, and major financing institution. Except for safety and warning signs, no other signs are permitted. Location as acceptable to the Architect.

L. Fire Prevention: Take every precaution to prevent fire. Provide and maintain in good operating condition suitable and adequate fire protection equipment and services, and comply with recommendations regarding fire protection made by the representative of the fire insurance company carrying insurance on the Work or by the local fire chief or fire marshal. The area within the site limits shall be kept orderly and clean, and all combustible rubbish shall be promptly removed from the site.

M. Egress: Maintain safe and legal means of egress at all times. At all times, provide at least two separate means of egress.

N. Temporary Elevators, Hoists & Cranes: Provide equipment required to complete the Work as required and to comply with approved schedules. Do not use project elevators for project or construction purposes without express written permission form the elevator manufacturer, the elevator installer and the Owner.

Provide design and engineering services of professional engineers registered in the locality to evaluated temporary elevators, hoists and crane. Systems used shall be based upon engineered documents stamped the Engineer of Record. Such Engineers shall have professional liability insurance covering the value of the Work.

O. Temporary Roads, Parking and Staging: Provide facilities necessary to accomplish the Work. Build temporary roads of adequate grade, substrate, and layout to provide safe, effective, efficient site work and access. Maintain roads and provide adequate temporary drainage. Provide parking required, whether on or off site. Pay all costs in connection with providing parking and ensure local traffic in, on, and around site is not adversely affected by workers or construction parking.

Provide staging or ensure staging is provided by subcontractors. Ensure staging is properly designed and where required, employ professional engineers in the locality to design or evaluate structural integrity of systems.

Where required provide or ensure subcontractors provide adequate closures of staging to ensure proper work temperatures and environmental safety.

P. Protecting Installed Construction: Comply with the requirements of Section 01 70 00 Execution and protect work until acceptance and Substantial Completion. Protect work not accepted at Substantial Completion or not yet installed and approved until Final Acceptance.

Q. Weather protection:
   a. Provide temporary enclosures and heat to permit construction work to be carried out continuously including during the months of November through March.
   b. Enclosures or heat for operations that are not feasible, practical or appropriate in the judgment of the Designer will not be required, and such as site work, steel erection, non-temperature sensitive exterior façade components, roofing and the like.
   c. Weather protection definition: Temporary protection for work adversely affected by moisture, wind, and cold, by means of covering, enclosing and/or heating.
   d. The General Contractor shall furnish and install all weather protection material and be responsible for all costs, including heating required to maintain a minimum temperature of 50 degrees F. at the working surface.
   e. Comply with safety regulations, and provide proper ventilation and fire protection systems. Prevent damage to surfaces, finishes and components.
   f. Monitoring: Provide thermometers throughout work areas.

R. Heating during construction:
   a. Submit for approval temporary heating methods within 30 days of contract award or within 14 days of need for same, whichever is sooner.
   b. The General Contractor shall provide and pay for temporary heating.
   c. Provide temporary heat continuously as required to provide proper temperatures around, in, and on the Work, its surfaces or components and to prevent the build up of improper amounts of moisture, humidity or other damaging conditions.
   d. Provide the temperature ranges necessary for the proper condition of the work, but within the range of 50 to 75 degrees F.
   e. Use of permanent heating system: Subject to review and approval of the Architect and their consultants, the system may be used. The system shall be turned over once the project is complete in like-new condition, completely clean and with warrantees unaffected by this use. The General contractor shall pay costs of this use including fuel, power, and labor necessary for the maintaining, operating, monitoring and cleaning of systems to both for utility usage and to subcontractors responsible for providing systems used.

1.14. PRODUCTS AND SUBSTITUTIONS

A. Specified Products: In all cases in which a manufacturer's name, trade name or other proprietary designation is used in connection with materials or articles to be furnished under this Contract, whether or not the phrase "or equal" is used after such name, the Contractor shall provide the product of the named manufacturers without substitution, unless a written request for a substitution has been submitted by the Contractor and approved in writing by the Architect as follows.

B. Deviations from Detailed Requirements: If the Contractor proposes to use material which, while suitable for the intended use, deviates in any way from the detailed requirements of the Contract Documents, the Contractor shall inform the Architect in writing of the nature of such deviations at the time the material is submitted for approval, and shall request written approval of the deviation from the requirements of the Contract Documents.

C. Approval of Substitutions: In requesting approval of deviations or substitutions, the Contractor shall provide evidence, including, but not limited to manufacturer's data, leading to a reasonable certainty that the proposed substitution or deviation will provide a quality of result at least equal to that attainable if the detailed requirements of the Contract Documents were strictly follows. If, in the opinion of the Architect, the evidence presented by the Contractor does not provide a sufficient basis for such reasonable certainty, the Architect may reject such substitution or deviation without further investigation.

D. Intent of Contract Documents: The Contract Documents are intended to produce a building of consistent character and quality of design. All components of the building including visible items of mechanical and electrical equipment have been selected to coordinate with the Design in relation to the overall appearance of the building. The Architect shall judge the design and appearance of proposed substitutes on the basis of the suitability in relation to the overall design of the Project, as well as for their intrinsic merits. The Architect will not approve, as equal to materials specified proposed, substitutes which in the Architect's opinion, would be out of character, obtrusive, or otherwise inconsistent with the character or quality of design of the Project. In order to permit coordinated design of color and finishes the Contractor shall furnish the substituted material in any color, finish texture, or pattern which would have been available from the manufacturer originally specified, at no additional cost to the owner.

E. Additional Costs or Impact: Any additional cost, or any loss or damage arising from the substitution of any material or any method for those originally specified shall be borne by the contractor, notwithstanding approval or acceptance of such substitution by the Owner or the Architect, unless such substitution was made at the written request or direction of the Owner and the Architect. Any decrease in the cost of the substitution shall be returned to the Owner.

F. Manufacturers: To the greatest degree possible, provide primary materials and products from one manufacturer for each type or kind. Provide secondary materials as recommended by manufacturers of primary materials.

G. Substitution Requests: Refer to relevant section and Substitution Request Form. Submit electronic copies. Identify product to be replaced by substitute by reference to specification sections and drawing numbers. Provide Contractor's certification and evidence to prove compliance with Contract. Document requirements as acceptable to Architect.

H. Substitution Conditions: Substitution requests will be returned without action unless one of the following conditions is satisfied. The Contractor shall state which of the following conditions applies to the requested substitution:
1. Request is due to an "or equal" clause.
2. Specified material or product cannot be coordinated with other work.
3. Specified material or product is not acceptable to authorities having jurisdiction.
4. Substantial advantage is offered Owner in terms of cost, time, or other valuable consideration.
5. Specified material or product is not available.

6. Invalid Substitutions: Contractor's submittal and Architect's acceptance of shop drawings, samples, product data or other submittal is not a valid request for, nor an approval of a substitution unless the Contractor presents the information when first submitted as a Request for Substitution.
7. Requests do not meet or exceed Sustainable Design Goals and Requirements.

1.15. DELIVERY, STORAGE AND HANDLING

A. Coordinate delivery to avoid delay in the Work. Strictly comply with manufacturer's or fabricators instructions and recommendations and prevent damage, deterioration and loss, including theft. Minimize long-term storage at the site. Maintain environmental conditions, temperature, ventilation, and humidity within range permitted by fabricator or manufacturers of materials and products used. Provide temporary supports and assemblies to maintain conditions and ensure work is stored to prevent distortion, warp or other deformation, degradation or damage. Determination satisfactory visual condition of stored work rests solely with the Architect.

1.16. MANUFACTURER RECOMMENDATIONS

A. Handle, store work as above. Install work according to manufacturer's recommendations, instructions, literature and product limitations. Where conflicts existing between these specifications and manufacturer recommendations, advise Architect in writing and obtain written recommendations to resolve conflict. Failure to install work according to standards, instructions and recommendations shall be the responsibility of the contractor. Replace work at no cost to Owner where not installed according to written requirements, instructions or recommendations.

1.17. LABELS

A. Labels, Trademarks, & Trade names: Locate required labels on inconspicuous surfaces. Do not provide labels, nameplates, or trademarks, which are not required. Provide permanent data plate on each item of equipment stating manufacturer, model, serial number, capacity, ratings and all other essential data.

1.18. RECORD DOCUMENTS

A. General: Keep record documents neatly and accurately. Record information as the work progresses and deliver to Architect at time of final acceptance. include in record documents all field changes made, all relevant dimensions, and all relevant details of the work. Keep record documents up to date with all field orders and change orders clearly indicated.

Form of Record Documents: As directed by Architect, using flash drives or upload to a file transfer site (Sync, DropBox, WeTransfer, or similar FTP site), notify Architect that documents are available for download, and maintain files online until Architect notifies Contractor in writing that Architect has downloaded files, and only if requested as hard copy on approved media.

B. Drawings: Keep four separate sets of prints at the site, one set each for mechanical, electrical, plumbing, and architectural/structural disciplines. Neatly and accurately note all deviations from the Contract Documents and the exact actual location of the work as installed. Marked-up and colored prints will be used as a guide to determine the progress of the work installed. Requisitions for payment will not be approved until the record documents are accurate and up-to-date

1. Work Outside Building: Record data outside of building to an accuracy of plus or minus 1 inch and determine and record the invert elevation of all drain lines.

2. At completion of the work, submit one complete set of marked-up prints for review. After acceptance these marked-up prints shall be used in the preparation of the record drawings.

3. Architect shall furnish Contractor with their standard computer-aided design files [hereafter “CAD”] for originals of the Contract Drawings. Make modifications to these files as shown on the marked-up prints. Remove superseded data to show the completed installation.

4. Deliver the completed record drawings on reproducible sheets and on an acceptable type of media [such as Flash drive] of the computer files, , properly titled and dated to the Architect. Indicate preparer of record drawings. These record drawings shall become the property of the Owner.

C. Specifications: Maintain one clean copy of complete specifications [including addenda, modifications, and bulletins with changes, substitutions, and selected options clearly noted. Circle or otherwise clearly indicate which manufacturer and products are actually used.

D. Operating and Maintenance Manuals: Manuals shall be submitted which contain the following:
1. Description of the system provided.
2. Handling, storage, and installation instructions.
3. Detailed description of the function of each principal component of the systems or equipment.
4. Operating procedures, including pre-startup, startup, normal operation, emergency shutdown, normal shutdown and troubleshooting.
5. Maintenance procedures including lubrication requirements, intervals between lubrication, preventative and repair procedures, and complete spare parts list with cross reference to original equipment manufacturer's part numbers.
6. Control and alarm features including schematic of control systems, control loop electric ladder diagrams, controller operating set points, settings for alarms and shutdown systems, pump curves and fan curves.
7. Safety and environmental considerations.

E. Copies of Operating and Maintenance Manuals: Three copies of the manuals shall be provided within sufficient time to allow for training of Owner's personnel. Submit one copy of the manuals to the Architect for review no latter than 90 calendar days prior to substantial completion, or building turn over, whichever comes first. Submit the remaining five copies within 15 days after first review set is returned to contractor. Progress payment may be withheld if this requirement is not met.

F. Additional Requirements for Operating and Maintenance Manuals: The requirements for manuals applies to each packaged and field-fabricated operating system. The manuals shall be provided in three-ring side binders with durable plastic covers. The manuals shall contain a detailed table of contents and have tab dividers for major sections and special equipment.

G. Framed Data: Provide charts and lists of all valves, circuits, switches, controls and equipment. Install on walls under glass at locations directed by Architect

1.19. EXTRA STOCK MATERIALS [aka "ATTIC" or "MAINTENANCE "STOCK]

A. Provide extra stock materials specified throughout Project Manual. Provide quantifies indicated, where extra stock is specified but quantities not indicated carry 1% of surface area of material installed; include at one of every color provided. Provide work in unopened boxes or containers of same lot or run of installed products. Identify, label and store products where directed.

1.20. SYSTEM DEMONSTRATION & TRAINING

A. Provide system demonstration and training as specified throughout the Project Manual and as follows, whether or not specified elsewhere:
1. Demonstrate project equipment and systems to ensure Owner personnel understand operation, functioning and long-term and short term maintenance of equipment and systems.
2. Explain and demonstrate systems restrictions, safety procedures and operational limitations.
3. Provide trained personnel which previous experience training and demonstrating systems. Devote sufficient time to each piece of equipment or system to ensure personnel have an effective understanding of requirements to operate and maintain work being demonstrated.

4. Provide follow-up and additional training where Owner advises that personnel need additional time to fully understand systems or equipment.
5. In general demonstration and training shall be conducted for all systems containing microprocessors, are programmable, convey people or goods, are affected by or part of safety or fire suppression systems, are part of environmental controls or require training in order to use or operate properly.
6. Make a video of demonstration session(s) and provide electronic files of same to the Owner.

1.21. PROJECT CLOSE OUT

A. Refer to General Contract language and requirements.

1.22. REMEDIAL WORK

A. Extent/Applicability: Remedial work includes cutting and patching associated with:
1. Defective, non-conforming, ill timed, and improperly fitting work.
2. Removing samples of installed work for testing, inspection, and verification.
3. Patching of sample removal locations.

B. Comply with the following:
1. Patching Materials: Identical in quality and appearance to materials to be cut and patched.
2. Craft: Employ highly skilled trade workers for all patching work.
3. Subcontractors: Coordinate their work with the General Contractor to minimize remedial work.
4. Make durable, permanent patches.
5. Comply with specified tolerances for similar new work.
6. Match the visual quality and character of adjacent unpatched work in good condition.
7. Create true, even surfaces with uniform, continuous appearance.
8. Extend patched area onto adjoining unpatched areas to eliminate visible evidence of patching.
9. Repaint entire assemblies, not only the patched area, to nearest major change of plane.
10. Obtain Architect's approval of each patch.
11. Visible evidence of patching is sufficient cause for rejection and replacement.

1.23. FINAL CLEANING AND REPAIR

A. The following is a resume of requirements.

B. Clean Up: immediately prior to the Architect's inspection for Substantial Completion, the Contractor shall completely clean the premises and clean and prepare the completed work in order for it to be used for its intended purpose in accordance with the Contract Documents. Such work shall include, but not be limited to the following:
1. Concrete and ceramic surfaces shall be cleaned and washed.
2. Resilient coverings shall be cleaned, waxed and buffed as applicable.
3. Woodwork shall be dusted and cleaned.
4. Sash, fixtures and equipment shall be thoroughly cleaned.
5. Stains, spots, dust, marks and smears shall be removed from all surfaces.
6. Hardware and metal surfaces shall be cleaned and polished.
7. Glass and plastic surfaces shall be thoroughly cleaned by professional window cleaners. Clean windows inside and outside.
8. Damaged, broken or scratched glass or plastic shall be replaced by the Contractor at the Contractor's expense.
9. Vacuum carpeted and soft surfaces with high efficiency particulate arrestor (HEPA) vacuum.
10. Use low-emitting, environmentally friendly cleaning agents and procedures.' 11. Comply with Owner's requirements for Green Housekeeping.

C. Repairs: Repair and touch-up all damaged and deteriorated products and surfaces.

1.24. E-DOC & CAD TRANSMITTAL REQUIREMENTS

A. Provide Electronic exchange of information and acceptable formats and file types; Where practical, all project documents.

B. Intent / purpose:
1. Purpose: Expediting exchange of information and approvals, and minimize time, cost and paper use, handling and storage.
2. Intent: To extent possible, provide required documentation in form of computer-readable files - hereafter: "e-docs".
3. Signing & sealing: As necessary, sign digitally and version-protect project documents so they are legally binding.
4. Use of paper is discouraged. Unless impractical, paper documents will have corresponding e-docs available and distributed to all parties.

C. Scope & Exceptions: Unless determined to be impractical for an acceptable reason, provide each of the following as an e-doc:
1. General purpose communications, contact information, meeting scheduling.
2. RFI inquiries and responses.
3. Sketches and sketch revisions.
4. Most submittals, including shop drawings, product information, MSDS representations, manufacturer's catalogs (complete or partial), and other customary submittals, along with Architect disposition of same.
5. Contractor's progress schedules.
6. Field orders.
7. Change order requests and proposals.
8. Photo documentation.
9. Punch lists.
10. Draft versions and review copies of documents requiring original signatures and/or notarization, including payment applications and executed change orders.

D. Produce and distribute hard copy paper records in quantities required in addition to the e-doc record for at least the following, subject to confirmation with the Architect:
1. Documents requiring multiple original signatures and/or notarization.
2. Applications for Payment.
3. Changer Orders.
4. Warranties.
5. Equipment operation & maintenance manuals.

E. File formats & Information Exchange: Comply with the following:
1. Preferred file format: Portable document format, PDF, Adobe Acrobat V.8 or later.
2. Combined pages: Submit related documents incorporated into single PDF files, as though stapled together. Include transmittal as part of file.
3. Acceptability: Properly identified, digitally signed/countersigned, pdf documents shall be binding upon the Project and its parties as if issued in paper form.

F. Email: Electronic email shall be an acceptable e-docs, binding upon the Project and its parties and equal in force to hardcopy or PDFs.
1. Use email applications having interoperability with all parties of the Project.
2. Use project name in subject line of each and every email issued; and include writer's name, address, telephone number and position in each email.

G. Acceptable picture / graphic file formats: "TIF", "GIF", and "JPEG".
1. Color in files: Acceptable, but not required.
2. Do not use other formats without approval of all parties.

H. Proprietary file formats: Do not use for e-docs unless all parties agree. These include:
1. MS Word.
2. PowerPoint.

3. MS Excel.
4. Photoshop.

I. File sizes, formats and naming conventions:
1. Use only agreed to, Project-accepted naming conventions for e-docs.
2. File sizes: Acceptable to internet service providers and parties servers.
3. Large files: Use FTP file transfer protocol up/down loads to pre-agreed servers.
4. Large files: DVD / CD ROMs disks may be used, only if FTP or DropBox sites are not available.
5. Maximum file size: Do not exceed 25 MGs without prior agreement of parties.
6. Files compression: Do not use Stuff-It, PK-ZIP or the like without prior agreement.
7. Unacceptable files: Unopenable, illegible, damaged, unintelligible files will be discarded without action. Originator shall correct and re-issue.

J. Cost of E-Doc Management: Each party to e-doc exchange shall maintain staff, programs and equipment, and storage adequate for generation, processing and archiving of e-docs as appropriate to their needs. Costs of for e-doc exchange and management shall be an internal overhead and administrative cost absorbed by each party.

K. Paper documents not also issued electronically and received by the Architect from the Contractor will be sent out for scanning to e-doc file and charged to Contractor or deducted from the Contract Sum.

L. If requested, Contractor, vendors, suppliers and subcontractors shall create their submittals in BIM file formats per Owner requirements with appropriate tags for facility management applications.

M. Terms, Conditions and requirements for transmittal of CAD files: Refer to Architect for requirements.

PART 2 -PRODUCTS [Not Used]

PART 3 -EXECUTION [Not Used]

END OF SECTION

SUBSTITUTION REQUEST FORM

No substitutions will be considered without this completed substitution request form and supporting documentation.

Substitutions made without completion of this form will be considered defective work as defined by the General Conditions of the Contract.

Date: _____ No.:_____

Project Name:_____

Project address:_____

To: Architect of Record

Re: _____

The Contractor proposes the following substitution in accordance with the Contract Documents.

Scope of Substitution _____

Spec. Section Reference _____
_____

Drawing Reference _____
_____

Drawing Reference _____
_____

Reason for proposed Substitution _____
_____
_____
_____
_____

Impact on project cost _____
_____

Impact on sustainable design characteristics _____
_____

Impact on project Schedule _____
_____

Impact on project _____

Guarantees & Warranties _____
_____

Coordination required with adjacent materials and systems _____

_____

_____

List deviations from specified requirements _____

_____

_____

Coordination required with adjacent materials and systems _____

_____

_____

Attachments: Attach supporting documentation sufficient for Architect to evaluate substitution. [Substitution forms lacking adequate documentation will be returned without review.]

Attachments _____

_____

_____

_____

Response date: List date by which response by Architect is requested to maintain project schedule and allow sufficient time for inclusion of proposed substitution.

Response Date _____

Submitted by _____

Firm _____

Address _____

_____

_____

Signature below signifies acceptance of responsibility for accuracy and completeness o f information included in this Substitution Request Form.

Authorized signature _____

ARCHITECT'S RESPONSE

Notations listed below shall have the same meaning as on Architect's approval stamp. Clarifications to or changes in project schedule or time shall be processed on standard project forms.

Architect's Response

_____Accepted / Reviewed
_____Accepted / Reviewed as corrected
_____Revise and resubmit
_____Rejected
_____Returned without review

Remarks _____

Date _____

Signed _____

END OF FORM

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2. As authorized in this completed agreement, you may modify and augment the Licensed Materials for use in preparing additional and related project documentation. Rauhaus Freedenfeld & Associates does not warrant the accuracy, completeness or appropriateness of the Licensed Materials for your use. In no event shall Rauhaus Freedenfeld & Associates be held liable for any damages as a result of your use of the Licensed Materials.
3. If specifically authorized in writing by Rauhaus Freedenfeld & Associates, you may rely on the Licensed Materials for use in a specific manner.

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This Agreement is the complete and exclusive statement of Agreement between the parties and supersedes all prior understandings or agreements, oral or written, between the parties relating to the subject matter of this agreement.

Authorized Representative: _____

Company(Transmitting Party): Rauhaus Freedenfeld & Associates

Signature: _____

Date: _____

Authorized Representative: _____

Company (Receiving Party): _____

Signature: _____

Date: _____

SECTION 01 35 30 - SAFETY

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section Includes, without limitation, providing:
1. Work place safety.
2. Public safety.
3. Compliance with OSHA and applicable safety provisions in force.
4. Safety officers.
5. Safety plan.
6. Emergency response.
7. Safety and accident reporting.

C. Extent: Each Prime Contractor is severally, individually and solely responsible for their portion of the work for providing for job site, work place and public safety and for complying with:
1. Applicable codes, laws, rules, regulations, and requirements of authorities having jurisdiction including, without limitation, Building Codes and OSHA regulations.

1.2 REFERENCES

A. Review safety provisions requirements. Confer with authorities having jurisdiction including:
1. Building officials.
2. Fire Department.
3. Police Department.

B. Without limitation, ensure compliance with:
1. 29 CFR, Part 1910: Occupational Safety and Health Administration (OSHA) General Industry and Health Standards.
2. 29 CFR, Part 1926: OSHA Construction Industry Standards.
3. 40 CFR, Part 61: National Emission Standards for Hazardous Air Pollutants.
4. 40 CFR, Part 261: Environmental Protection Agency (EPA) Characteristics of Hazardous Waste.
5. 40 CFR, Part 761, EPA Polychlorinated Biphenyls (PCBs), Manufacturing, Processing, Distribution in Commerce and Use Prohibitions.
6. 40 CFR, Part 763: EPA Asbestos.

1.3 SAFETY OFFICERS

A. Designate a Primary Safety Officer and Deputy Safety Officer. Each Safety Officer shall:
1. Be responsible for safety at the Project site.
2. Have at least 5 years experience as a Safety Officer.
3. Be formally trained:
   a. With at least 10 hours of OSHA regulations training.
   b. In first aid and CPR.
   c. In Federal, State, and Local environmental rules and regulations.
4. Be on site whenever any Contract activity is in progress.
5. Have the authority to direct all workers and subcontractors to prevent unsafe conditions.
6. Have the authority to penalize subcontractors and workers for safety violations.
7. Be subject to approval of the Owner and Architect. Replace unacceptable persons.

B. The Safety Officer may be the Project Superintendent or other employees.

C. The Deputy Safety Officer may cover the Primary Safety Officer's reasonable absences.

1.4 SAFETY PLAN

A. Documentation: At least 10 days prior to beginning any work on site, prepare and submit a written Safety Plan.
   1. The Owner and Architect may review the safety plan and may make suggestions.
   2. The Owner's and Architect's option to review and suggest does not transfer any safety responsibility to the Owner or Architect. The Contractor remains solely responsible for safety.

B. Enforcement: The General Contractor shall enforce the Safety Plan and require all on-site workers to comply with the Safety Plan.

C. Plan Content: Address at least the following topics:
   1. OSHA requirements including 29CFR1926 and applicable parts of 29CFR1910.
   2. Applicable State and local regulations.
   3. Safety Officer identification and responsibilities including daily inspections.
   4. Deputy Safety Officer identification and responsibilities including daily inspections.
   5. Safety Officer and Deputy Safety Officer shall meet the OSHA "Competent Person Standard".
   6. Emergency response procedures.
   7. Accident avoidance.
   8. Hazard communications including HazCom program and MSDS program.
   9. Work Hazard Analysis and Response created and followed for each work activity.
   10. Safety Plan orientation for all workers prior to their beginning work on site.
   11. Weekly safety meetings and training with attendance required and attendance log maintained.
   12. Accident Reports within 24 hours after each incident. See additional requirements below.
   13. Principal's Meeting within 72 hours after each Lost Time Accident.
   14. Action Plan for immediate dangers to health and safety.
   15. Worker discipline program including verbal warning, written warning, and dismissal.
   16. Subcontractor discipline program including warnings and penalties.
   17. Personal Protective Equipment standards including, without limitation:
      a. Hard hats.
      b. Safety glasses.
      c. Foot wear.
      d. Clothing including shirt sleeves and pants length.
      e. Occupational noise protection.
      f. Respirators.
   18. Controlled substances including illegal drugs and alcohol.
   19. Worker disputes and fighting.
   20. Possession of weapons on site.
   21. Daily scaffolding inspection and documentation.
   22. Fall protection including without limitation:
      a. "Baker" stages and working platforms 48 inches or higher.
      b. Steel erection with 100 percent individual worker restraint as primary protection.
      c. Holes, pits, excavations, openings in decks, and similar hazards.
   23. "Hot work" permits, fire prevention, and fire watches.
   24. Independent third party inspection of cranes, hoists, lifts, and similar machines.
   25. Temporary electric power including ground fault circuit interrupter protection.
   26. Electric powered tools including double insulation requirements.
   27. Electric extension power cords including condition, grounding, and capacity requirements.
   28. Confined spaces special procedures including OSHA 1910.146.
   29. House keeping, general cleaning, and combustible waste storage and removal.
   30. Flammable material use, storage, and disposal requirements.
   31. Protection of public ways and management of danger to the public.
   32. Additional topics determined by the Contractor.

1.5 SPECIAL FIRE SAFETY & HOT WORK PRECAUTIONS

A. Comply with section 01 73 60; if not included, as follows:

B. Ensure operations involving use of open-flame, electrical arc equipment or flammable substances are not conducted until a permit for welding, cutting, and burning has been completed, signed and issued by authorities having jurisdiction.

C. Prior to commencing operations, a positive determination shall be made that it is impractical to conduct the hot work in a shop area or outside of the building. Coordinate suitable locations for hot equipment operations agreeable to Owner's Representatives.

D. Provide precautions recommended by the Fire Department and at least the following:
1. Absences of flammable liquids or vapors in the vicinity of the work.
2. Minimum radius of combustibles near the work, or provision of fire blankets or other suitable protectives and baffles.
3. Inspection of hot work areas not less than 60 minutes after completion.
4. Portable fire extinguishers or operational sprinkler system.
5. Trained fire watch personnel.

1.6 EMERGENCY RESPONSE

A. Plans: As part of the Safety Plan, prepare “Emergency Response Plans” which identify actions to be taken, persons responsible for each action, contact telephone numbers of all authorities having jurisdiction, governmental emergency telephone numbers, and other information. Prepare separate “Emergency Response Plans” for each of the following situations.
1. Personal injury.
2. Fire.
3. Explosion.
4. Chemical hazard.
5. Environmental hazard.
6. Electrical hazard.
7. Wind storm.

B. First Aid: Provide and maintain, well supplied, industrial quality, first aid kits.

C. Emergency Assistance Access: Post emergency telephone numbers for medical, fire, and police in clearly visible locations. Provide readily available and accessible telephones and radios.

D. Accident Reports: Prepare detailed, written reports for each incident including:
1. A brief summary of the incident.
2. A chronological list of the sequence of events.
3. Names of all persons involved in the incident.
4. List of injuries and damage with as much detail as possible.
5. The actions and emergency response to the incident including names of persons taking action.
6. Other important and relevant information.
7. Comply with insurance carrier requirements and unless otherwise indicated submit accident reports to within time required, as specified herein or less.

PART 2 - PRODUCTS Not used.

PART 3 - EXECUTION.

3.1 EMERGENCY SUSPENSION OF WORK

A. When the Contractor becomes aware or is notified of non-compliance with safety or health provisions immediately, correct the unsafe or unhealthy condition.
1. When, in the opinion of authorities having jurisdiction, satisfactory corrective action has been taken by the Contractor, work shall resume.

2. No extension of time or compensation for damages in connection with a work stoppage for an unsafe or unhealthy condition will be permitted.

3.2 PROTECTION OF PERSONNEL

A. Take all necessary precautions to prevent injury to the public, occupants, or damage to property of others. The public and occupants includes all persons not employed by the Contractor or a subcontractor.

B. Wherever practical, the work area shall be fenced, barricaded or otherwise blocked off from the public or occupants to prevent unauthorized entry into the work area.
1. Provide traffic barricades and traffic control signage where construction activities occur in vehicular areas.
2. Corridors, aisles, stairways, doors and exitways shall not be obstructed or used in a manner to encroach upon routes of ingress or egress utilized by the public or occupants, or to present an unsafe or unhealthy condition to the public or occupants.
3. Store, position and use equipment, tools, materials, scraps and trash in a manner that does not present a hazard to the public or occupants by accidental shiftings, ignition or other hazardous activity.
4. Store and transport refuse and debris in a manner to prevent unsafe and unhealthy conditions for the public and occupants. Cover refuse containers, and remove refuse on a frequent regular basis acceptable to the Contracting Officer. Use tarpaulins or other means to prevent loose transported materials from dropping from trucks.

3.3 ENVIRONMENTAL PROTECTION

A. Dispose of solid, liquid and gaseous contaminants in accordance with local codes, laws, ordinances and regulations.

B. Comply with applicable federal, state and local noise control laws, ordinances and regulations, including but not limited to 29 CFR 1910.95 and 29 CFR 1926.52.

END OF SECTION

SECTION 01 43 00 - QUALITY CONTROL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and other Division 01 Specification Sections, apply to this Section.

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

C. Extent: Specific test and inspection requirements are not specified in this Section; see other sections.

1.2 ADMINISTRATION & PROCEDURES

A. Quality Monitoring: For their portion of the Work, Prime Contractors shall Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality. Perform quality control procedures and inspections during installation. Quality control shall include:
1. Quality assurance services performed before and during execution of the work.
2. Quality control services performed after execution of the work.
3. Mock-ups, whether separate or integrated into the work.
4. Product testing performed by manufacturers.
5. Source quality control testing performed at plant, mill, factory or shop.
6. Field quality control on-site testing and inspection.

B. Owner Responsibilities: Where quality-control services are listed below as Owner's responsibility, Owner will engage a qualified testing agency to perform these services. These are:
1. Steel testing.
2. Concrete testing.
3. Soil compaction testing.

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

D. Standards: Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Tolerances: Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate. Comply with manufacturers' tolerances.

F. Reference Standards: For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

G. Manufacturer’s Field Services: When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to perform the following as applicable, and to initiate instructions when necessary.
1. Observe site conditions.
2. Conditions of surfaces and installation.
3. Quality of workmanship.
4. Start-up of equipment.
5. Test, adjust and balance of equipment.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.3 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data : For Contractor's quality-control personnel.

C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

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 Architect.
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 Architect's.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, 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 01 70 00 "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

SECTION 01 57 10 - CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Implementation of waste management controls and systems for the duration of the Work.
2. Compliance with LEED requirements for indicated version.

1.2 INTENT

A. To minimize waste and maximize recycling in accordance with current Best Practices.

B. The Owner and Architect have established that this Project shall generate the least amount of waste practical and that processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors shall be employed.

C. Of the waste that is generated, as many of the waste materials as economically feasible shall be reused, salvaged, or recycled. Waste disposal in landfills shall be minimized to the greatest extent practical.

D. With regard to these goals each Prime Contractor shall develop, for the Architect's review, a Waste Management Plan for this Project.

E. Each Subcontractor shall be responsible for segregating his own waste into different dumpsters as directed by the Contractor.

F. Where Owner, Tenant or Building Management maintains standards for demolition and materials waste handling, comply with same. Refer to Owner for applicable documents.

G. Contractor shall be responsible for ensuring that debris will be disposed of at appropriately designated licensed solid waste disposal facilities, local and state codes.

H. Sustainability: Comply with:
1. Sustainable design targets and options identified in Section 01 81 13.
2. Demolitions and waste recycling identified in Section 01 81 13. [Note: requirement is 75%].

I. Demolition waste shall be included in the Waste Management Plan and monthly reports in addition to construction waste.

J. Monthly Waste reports shall show how much waste was diverted and how much was not. Project specific results must be provided; facility or company averages cannot be used.

K. Use of the same dumpsters for multiple adjacent properties is prohibited.

1.3 SUBMITTALS

A. Provide a complete set of submittals including the following:
1. Waste Management Plan.
2. Landfill options.
3. Alternatives to Landfill.
4. Planned meetings.
5. Materials handling procedures.
6. Materials transportation procedures.
7. Progress and final reports.

B. Waste Management Plan: Within 21 calendar days after receipt of Notice to Proceed, the Contractor shall provide a plan containing the following:
1. Analysis of the proposed job site waste to be generated, including types and rough quantities. Include
   a. Not less than 5 materials targeted for diversion.
   b. Identify which will be separated and which commingled.
   c. Identify percentage of overall project waste materials represent.

d. Identify where materials will be taken and how processed.
e. Identify requirements of LEED perquisites and credits indicated in the LEED checklist or credit sheet.

2. Landfill Options: The name of the landfills where trash and building debris will be disposed of, the applicable landfill tipping fees, and the projected cost of disposing of all Project waste in the landfills.
3. Landfill Certification: Contractor's statement of verification that landfills proposed for use are licensed for types of waste to be deposited and have sufficient capacity to receive waste from this project.
4. Alternatives to Land filling: A list of each material proposed to be salvaged or recycled during the course of the Project. Include the following and any additional items proposed:
   a. Cardboard.
   b. Clean dimensional wood.
   c. Beverage containers.
   d. Land clearing debris; this debris shall not be included as waste diversion.
   e. Concrete.
   f. Bricks and masonry.
   g. Asphalt.
   h. Metals from framing, banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized sheet steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
   i. Mechanical and electrical equipment.
   j. Building components which can be removed relatively intact from existing construction.
   k. Packaging materials.
5. Meetings: A description of the regular meetings to be held to address waste management.
6. Materials Handling Procedures: A description of the means by which any waste materials identified above will be protected from contamination, and a description of the means to be employed in recycling the above materials consistent with requirements for acceptance by designated facilities.
7. Transportation: A description of the means of transportation of the recyclable materials (whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site) and destination of materials.

B. Waste Management Progress Report: Concurrent with each Application for Payment, submit a written Waste Management Progress Report in the same format as required for Final Report.

C. Waste Management Final Report: Prior to Substantial Completion, submit a written Waste Management Final Report summarizing the types and quantities of materials recycled and disposed of under the Waste Management Plan. Include the name and location of disposal facilities.

1.4 CONTRACTOR

A. Contractor may subcontract work of this Section to a sub-contractor specializing in recycling and salvaging of construction waste.
   1. Institution Recycling Network, Concord, NH 03301.
   2. Or equal as approved by the Architect.

PART 2 PRODUCTS Not Used.

PART 3 EXECUTION

3.1 RECYCLING

A. Metal, including but not limited to aluminum stairs, structural beams and sections, and reinforcing steel shall be recycled.

B. Wood that is not painted and does not contain preservatives (i.e. creosote, arsenic, and chromium-containing preservatives) shall be segregated and recycled.

C. Refer to the Massachusetts Recycling Directory available at the Massachusetts State Bookstore (617-727-2834) in the State Capitol Building for recycling operations within the State.

3.2 WASTE MANAGEMENT PLAN IMPLEMENTATION

A. Manager: The Contractor shall designate an on-site person responsible for instructing workers and overseeing and documenting results of the Waste Management Plan for the Project.

B. Distribution: The Contractor shall distribute copies of the Waste Management Plan to the Job Site Foreman, each Subcontractor, the Owner and the Architect.

C. Instruction: The Contractor shall provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the Project.

D. Calculations: Provide calculations meeting LEED requirements and consistently either by weight or volume but not both; identify selected option requirements on each sheet.

E. Separation Facilities: The Contractor shall lay out and label a specific area to facilitate separation of materials for recycling, salvage, reuse, and return. Recycling and waste bin areas are to be kept neat and clean and clearly marked in order to avoid contamination of materials. Location shall be acceptable to the Architect.

E. Hazardous Wastes: Any unforeseen hazardous wastes shall be separated, stored, and disposed of according to local regulations and as directed by the Owner.

END OF SECTION

SECTION 01 70 00 - EXECUTION REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: All of the Contract Documents, including the Drawings, and Division 1 General Requirements apply to the work of this Section.

B. Section includes: General execution requirements.

1.2 INSPECTION & EXAMINATION

A. Examine and inspect work daily to ensure compliance with Contract Documents and comply with the following:
1. Inspection by Contractor, subcontractors or installers:
   a. Inspect work of other trades to ensure areas are ready to receive next phase of work.
   b. Verify required work of other sections or trades is properly and fully installed before proceeding.
   c. Examine previous work, related work and conditions.
   d. Take action to ensure defects are corrected.
2. Notify in writing Contractor, Architect and where applicable, Owner, of deficiencies or conditions detrimental to proper completion of the Work.

B. Acceptance: Beginning installation or execution of work constitutes acceptance and approval of previous work, related work and conditions.

1.3 TOLERANCES & MEASUREMENT

A. Confirm measurements and dimensions and comply with the following:
1. Do not deviate from measurements and dimensions of Contract documents without written authorization to do so from the Architect.
2. Field check measurements and tolerances periodically and regularly.
3. Notify Architect in writing of differences between field and Contract Documents. Submit drawings showing differences.
4. Confirm tolerances and do not allow them to grow or accumulate.

B. Tolerances: Unless otherwise shown, indicated, specified or approved in writing, install work plumb, aligned, and straight as follows:
1. 48 inches or less: within 0.06 inch.
2. 10 feet or less: within 0.125 inch.
3. 20 feet or less: within 0.18 inch.
4. Over 20 feet: Within 0.25 inch.

1.4 APPROVALS, INSPECTIONS, FIELD QUALITY CONTROL

A. Obtain required inspections and approvals of authorities having jurisdiction before concealing applicable work.

B. Field Quality Control: Perform or coordinate with those performing, required field quality control, field tests and the like.

1.5 LAYOUT

A. Employ skilled, experienced person to establish lines, elevations and layout of the work and comply with the following:
1. Provide and maintain layout lines, benchmarks, and necessary working points.

2. Do not change, deviate or alter indicated lines and elevations without prior written approval from the Architect.

B. Architect's review of interior layout:
1. Layout interior partitions and doorways on floor.
2. Do not continue to work without Architect's approval.
3. Do not alter layout without written approval from Architect.

C. Floor finishes: Unless otherwise specifically indicated:
1. Extend floor finishes under open bottom items, movable items, furnishings, equipment and casework.
2. Extend into closets, recesses, alcoves and toe spaces.
3. Extend tight to walls, columns, permanent work.

1.6 ADJUSTING

A. Adjust operable items to operate freely and properly.

1.7 AIR INFILTRATION & FREEZE PROTECTION

A. General: Ensure the building envelope provides a continuous barrier to air infiltration and to freeze damage. Upon completion the building envelope shall:
1. Separate all occupied and mechanical spaces from exterior temperatures with weather tight construction as necessary to protect against freezing or excessive heat loss.
2. Provide solid blocking, sheathing and/or framing to support construction to accomplish this requirement.

B. Extent of Contractor obligation: As part of this Contract, be responsible for any and all damages which occur due to lack of weather tight construction.

C. Air Infiltration: Comply with provisions of other sections. Ensure different components forming the air infiltration barrier system are interconnected and sealed together without discontinuities or open penetrations.

D. Freeze protection: Construct assemblies to ensure the typical thermal and air barrier systems are on the cold-in-winter side of work subject to freezing. In particular, soffits, ceilings and chases subject to freezing shall only be constructed after typical assemblies are insulated and finished off.

1.8 CLEANING

A. Clean work areas daily. Do not permit debris to accumulate.

B. Clean completed work using appropriate materials complying with Contract Documents and manufacturer recommendations, instructions and limitations.

C. Comply with application sustainability requirements, if any, including:
1. Cleaning materials.
2. Indoor air quality.
3. Construction waste disposal.

1.9 PROTECTION / ISOLATION

A. Protect installed work from damage or deterioration and as follows:
1. Restrict traffic from completed protected work or areas.
2. Prohibit traffic, storage or other work from waterproofing and roofing.
3. Protect doors, frames, and hardware.
4. Protect glass from damage, scratches, or stains.
5. Maintain proper humidity levels and protect work from dampness, moisture, stains, marks or abrasions.

6. Replace work with evidence of growths, mold or mildew.
7. Replace damaged or deteriorated work with new acceptable work complying with Contract Documents.

B. Isolate dissimilar metals from galvanic action or corrosion with non-absorptive dielectric material, tape or coatings of type recommended by manufacturer or approved by Architect.

PART 2 - PRODUCTS Not used

PART 3 - EXECUTION Not used

END OF SECTION

DOCUMENT 01 70 53 – TAX EXEMPTION USAGE REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Document Includes, without limitation, requirements for usage of:
   1. Owner's tax exemption.

C. Tax exemption: The Owner is exempt for the payment of sales taxes on materials and products permanently incorporated into the work.

D. Extent of Contractor responsibilities for tax exemption usage, without limitation, includes:
   1. Notices & verification:
      a. Obtain from Owner their tax exempt documentation and obtain.
      b. Complete forms required by the state Department of Revenue.
      c. Comply with state filing and regulatory requirements.
   2. Records: Providing Owner with one copy of each purchase order, invoice, and receipt which used the Owner's tax exemption certificate number.
   3. Certification: Upon Contract completion, provide a notarized certification to the Owner stating that all purchases made under the Owner's tax exemption certificate number were legitimate, for this Contract, and entitled to the exemption.

E. Penalties: Pay all penalties assessed by authorities having jurisdiction for the Contractor's improper or illegal use of the Owner's tax exemption certificate number.

END OF DOCUMENT

SECTION 01 78 00 - EXTRA STOCK & SPARE PARTS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 specification sections, apply to this Section.

B. Section Includes, without limitation, providing:
1. Close out documentation.
2. Spare parts & tools.
3. Maintenance materials.
4. Extra materials [aka "Attic Stock"].

C. Completion of this section is a condition of acceptance.

D. Related requirements includes, without limitation:
1. Division 1 - Closeout requirements.
2. Balance of specifications sections.

1.2 SUBMITTALS

A. Comply with Division 1 General Requirements and submit:
1. Closeout goods or materials with accompanying transmittal for each as follows:.
   a. Spare parts.
   b. Maintenance materials.
   c. Extra stock.
2. Documentation to include Owner acceptance and proof of receipt.

PART 2 - PRODUCTS

2.1 SPARE PARTS & TOOLS

A. Package items in clearly identified, labeled boxes, and indicate:
1. Manufacturer's name, part number and stock number.
2. Use, purpose and equipment associated with part, tool or component.
3. Name, address, and phone number of closest supplier.

2.2 MAINTENANCE MATERIALS

A. Package items in clearly identified, labeled boxes, and indicate:
1. Trade name and stock number.
2. Use and item or function associated with material.
3. Name, address, and phone number of closest supplier.

B. Provide complete installation instructions including tolerances, limitations and restrictions.

2.3 EXTRA MATERIALS aka "ATTIC STOCK"

A. Package items in clearly identified, labeled containers, boxes or wrappers, and indicate:
1. Trade name, lot number, stock number, size, color and the like.
2. Location[s] or area[s] where product been installed in the Project.
3. Name, address, and phone number of closest supplier.

PART 3 - EXECUTION

3.1 DELIVERY

A. Deliver required materials, tools, components and goods to Owner as follows:
1. At least 60 days before Acceptance unless Owner requests earlier delivery.
2. To location directed by Owner. Neatly stack materials with labels face out.
3. With approved transmittal form[s] bearing Owner acceptance of each item.

3.2 SCHEDULE OF EXTRA ATTIC STOCK MATERIALS

A. Confer with Owner during bidding and pricing process and identify what the Owner does and does not want.

B. In the event, the Owner does not define attic stock and related requirements, provide the quantities indicated in the respective sections or as specified below, which ever is greater.

C. Identifying scope of attic stock and spare parts required is an integral part of the work of the Contractor for this project.

D. Provide extra stock before installation begins as follows:
1. Shingles: 5% amount of each type.
2. Acoustical ceilings and suspension: 5% amount of each type.
3. Floor tile: One unopened carton from the same run for each 1000 square feet of floor surface
4. Floor tile accessories: 20 feet same run for each 1000 linear feet to be installed.
5. Sheet carpet: 50 square yards of each type, color and pattern installed, in one piece, not surplus scraps.
6. Carpet tile: 50 square yards of each type, color and pattern installed, in boxes.
7. Wall covering: 2% amount of each color and style.
8. Paint: From original batch mix of each type to be installed, unopened, and as required for the products used in this project, generally as follows:
    a. Exterior Finish: Two 5-gallon cans, each type and color.
    b. Interior Flat Finish: Six 5-gallon cans, each type and color.
    c. Exterior Semigloss Finish: Two 5-gallon cans, each type and color.
    d. Interior Semigloss Finish: Two 5-gallon cans, each type and color.
9. Window treatment: 5 % of each type required.

END OF SECTION

SECTION 01 81 13 - SUSTAINABLE DESIGN REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: The general provisions of the Contract, and Division I, General Requirements, apply to work specified in this Section, and are hereby made a part of this Section of the Specifications. PART A and DIVISION 1 of PART B are hereby made a part of this Section.

B. This Section includes general requirements and procedures for the LEED Certification process.

C. Sustainable Design Intent: Comply with project requirements to achieve a LEED-CI v4 Gold Rating, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council.
1. Comply with LEED (Leadership in Energy and Environmental Design) For Commercial Interiors Green Building Rating System version 4 (LEED-CI v4).
2. Refer to LEED Checklist/Scorecard attached at the end of this Section.
3. Requirements in Section 01 81 13 shall supersede requirements contained in other sections, where conflicting sustainable design and submittal requirements may be listed.

D. Contractor is responsible for compliance with and completion of the required documentation for the following LEED Credits:
1. Materials and Resources Prerequisite: Construction and Demolition Waste Management Planning
2. Materials and Resources Credit: Construction and Demolition Waste Management (2 points)
3. Materials and Resources Credit: Building Product Disclosure and Optimization – Environmental Product Declarations (Option 1 – EPDs, 1 point)
4. Materials and Resources Credit: Building Product Disclosure and Optimization – Sourcing of Raw Materials (Option 2 – Leadership Extraction Practices, 1 point)
5. Materials and Resources Credit: Building Product Disclosure and Optimization – Material Ingredients (Option 1 – Material Ingredient Reporting, 1 point)
6. Indoor Environmental Quality Credit: Low Emitting Materials (1 point) – compliance categories include:
   - Paints and Coatings
   - Flooring
   - Products containing composite wood or agrifiber products and/or wood glues.
7. Indoor Environmental Quality Credit IAQ Management Plan (1 point)

D. Contractor is responsible for coordinating with the Early Demolition phase contractors to substantiate compliance with the following credits:
1. Materials and Resources Prerequisite: Construction and Demolition Waste Management Planning
2. Materials and Resources Credit: Construction and Demolition Waste Management (2 points)

E. Contractor is responsible for coordinating with the Owner and the Owner's consultants, including but not limited to the Architect, Engineers, and Commissioning Agent, in their efforts associated with all other LEED credits. Specifically, the contractor shall support and assist third parties with the following credits. Support shall include, but is not limited to, scheduling assistance, coordination with affected sub-trades, ensuring timely access to work areas, use of on-site equipment (such as ladders, hand tools, or cleaning equipment), etc. Allow for both project management and field supervision time for these activities.
1. Energy and Atmosphere Prerequisite: Fundamental Commissioning and Verification
   a. To be performed by the Owner's Commissioning Agent
   b. See 01 91 13 General Commissioning
   c. For more information, see: https://www.usgbc.org/node/2732691?view=language
2. Energy and Atmosphere Credit: Enhanced Commissioning
   a. To be performed by the Owner's Commissioning Agent
   b. See 01 91 13 General Commissioning
   c. For more information, see: https://www.usgbc.org/node/2613057?view=language
3. Indoor Environmental Quality Credit: Indoor Air Quality Assessment

a. To be performed under supervision of the Owner's Commissioning Agent
b. For more information, see: https://www.usgbc.org/node/4378081?view=language

F. Additional credit specific requirement information is available in the USGBC LEED-CI v4 credit library or within the USGBC's LEED ID+C Reference Guide:
https://www.usgbc.org/credits/commercial-interiors/v4
OR
The U.S. Green Building Council (USGBC)
2101 L Street, NW
Suite 500
Washington, DC 20037
Website: www.usgbc.org

1.2 RELATED WORK

A. Examine Contract Documents for requirements that affect the work of this Section. Other Specification Sections that relate directly to work of this Section include, but are not limited to:
Section 01 57 10, Construction Waste Management.
Section 01 51 50, Construction Indoor Air Quality.
Section 01 91 13, General Commissioning.
Individual Specifications Sections identifying sustainable requirements.

1.3 DEFINITIONS

B. Agrifiber Products: Composite panel products derived from recovered agricultural waste fiber from sources including, but not limited to, cereal straw, sugarcane bagasse, sunflower husk, walnut shells, coconut husks, and agricultural prunings.

C. CDPH Standard Method v1.1: California Department of Public Health (CDPH) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, v1.1-2010, for the emissions testing and requirements of products and materials.

D. Composite Wood: A product consisting of wood fiber or other plant particles bonded together by a resin or binder.

E. Construction and Demolition Waste: Includes solid wastes, such as building materials, packaging, rubbish, debris, and rubble resulting from construction, remodeling, repair and demolition operations. A construction waste management plan is to be provided by the Contractor as defined in Section 01 57 10.

F. EPD: Environmental Product Declaration. A statement that the items meet the environmental requirements of ISO 14021-1999, ISO 14025-2006 and EN15804 or ISO 21930-2007.
1. Product-Specific Declaration: A product with a publicly available, critically reviewed life-cycle assessment conforming to ISO 14044 that has at least a cradle to gate scope.
2. Industry-Wide (Generic) EPD: Provide products with third-party certification (Type III), including external verification, in which the manufacturer is explicitly recognized as a participant by the program operator. EPD must conform to ISO 14025, 14040, 14044, and EN 15804 or ISO 21930 and have at least a cradle to gate scope.
3. Product-Specific Type III EPD: A product with a third-party certification, including external verification, in which the manufacturer is explicated recognized by the program operator. EPD must conform to ISO 14025, 14040, 14044, and EN 15804 or ISO 21930 and have at least a cradle to gate scope.

G. LCCA: Life Cycle Cost Analysis is a tool to determine the most cost-effective option among different competing alternatives to purchase, own, operate, maintain and, finally, dispose of an object or process, when each is equally appropriate to be implemented on technical grounds.

H. LEED: The Leadership in Energy & Environmental Design green building rating systems developed and adopted by the U.S. Green Building Council

I. Sealant: Any material that fills and seals gaps between other materials

J. Volatile Organic Compounds (VOCs): Any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions. Compounds that have negligible photochemical reactivity, listed in EPA 40 CFR 51.100(s), are also excluded from this regulatory definition.

1.4 SUBMITTALS

A. General: Submit each LEED submittal simultaneously with applicable product submittal.

B. LEED Documentation Submittals:
1. General, Product Data Reporting Form: Project submittals must be accompanied by a completed Product Data Reporting Form. Submittal packages must also include highlighted documentation supporting the sustainability claims made on the Product Data Reporting Form.

C. Sustainable Design Submittals Materials and Resources:
1. Applicable Reference Standards:
- International Standard ISO 14021-1999, Environmental labels and declarations – Self Declared Claims (Type II Environmental Labeling): iso.org
- International Standard ISO 14025-2006, Environmental labels and declarations – Self Declared Claims (Type III Environmental Declarations – Principles and Procedures): iso.org
- International Standard ISO 14040-2006, Environmental management, Life cycle assessment principles, and frameworks: isg.org
- International Standard ISO 14044-2006, Environmental management, Life cycle assessment requirements, and guidelines: iso.org
- International Standard ISO 2193-2007 Sustainability in building construction-Environmental Declaration of building products: iso.org
- Federal Trade Commission, Guides for the Use of Environmental Marketing Claims, 16 CFR 26.7 (e): ftc.gov/bcp/grnrule/guide980427.htm
- Health Product Declarations: hpdcollaborative.org/
- Cradle-to-Cradle Certified Product Standard: c2ccertified.org/product certification
- GreenScreen: cleanproduction.org/Greenscreen.vi-2.php

2. Submittal requirements:
a. Construction and Demolition Waste Management: Comply with submittal requirements of Section 01 57 10 "Construction Waste Management".
b. Building Product Disclosure and Optimization: Environmental Product Declarations complying with LEED requirements: Submittals for materials and products that may contribute to the documentation.
1) Provide EPDs that conform to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930 and have a cradle to gate scope. Industry-Wide EPDs and Product-Specific Type III EPDs are acceptable.
c. Building Product Disclosure and Optimization: Product data, containing information regarding recycled content, compliant wood certification, reused material value, and bio-based material percentages, if applicable.
d. Building Product Disclosure and Optimization: Material Ingredient Reporting complying with LEED requirements: Submittals for materials and products that may contribute to the documentation include but are not limited to:
1) Provide HPDs that provide full disclosure of known hazards in compliance with the Health Product Declaration open Standard.
2) Provide Cradle to Cradle certification documentation
3) Provide Declare product label indicating all ingredients evaluated and disclosed
e. Indoor Air Quality Management Plan: Comply with submittal requirements of Section 01 51 50, "Construction Indoor Air Quality".
f. Low-Emitting Materials: Product data, containing VOC content and General Emissions Evaluation documents that indicate compliance with requirements for low-emitting materials, for the following materials:

1) Paints and coatings.
2) Flooring.
3) Products containing composite wood or agrifiber products or wood glues.

D. Project Materials Cost Data: Provide a spreadsheet in an electronic file indicating the total cost for the Project and the total cost of building materials used for the Project, as follows:
1. Not more than 60 days after the Preconstruction Meeting, the General Contractor shall provide to the Owner and Architect a preliminary schedule of materials costs for all materials used for the Project organized by specification section. Costs exclude site labor, overhead, and profit. Include breakout of costs for the following categories of items:
   - Wood construction materials.
   - Furniture.
   - Passive plumbing materials.
   - Passive mechanical (HVAC) materials.
   - Passive electrical materials.
   - Earthwork and exterior improvements, hard costs.
2. Provide final versions of the above spreadsheets to the Owner and Architect not more than 14 days after Substantial Completion.

1.5 QUALITY ASSURANCE

A. General: Perform the work of this Section as a supplement and in accordance with applicable requirements of Division 1 “Contractor Quality Control Program.”
1. Preconstruction Meeting: After award of Contract and prior to the commencement of the Work, schedule and conduct meeting with Owner, Architect, and all Subcontractors to discuss the Construction Waste Management Plan, the required Construction Indoor Air Quality (IAQ) Management Plan, and all other Sustainable Design Requirements. The purpose of this meeting is to develop a mutual understanding of the Project’s Sustainable Design Requirements and coordination of the Contractor’s management of these requirements with the Contracting Officer and the Construction Quality Manager.
2. Construction Job Conferences: The status of compliance with the Sustainable Design Requirements of these specifications will be an agenda item at all regular job meetings conducted during the course of work at the site.

PART 2 - PRODUCTS

2.1 PRODUCT ENVIRONMENTAL REQUIREMENTS

A. Building Product Disclosure and Optimization, Environmental Product Declarations (EPD): Option 1. Provide at least 20 permanently installed products (sourced from at least 5 different manufacturers) which meet one of the following disclosure criteria:
1. Product-Specific Declaration: Valued as one quarter (1/4) of a product.
2. Industry-Wide (Generic) EPD: Valued as one half (1/2) of a product.
3. Product-Specific Type III EPD: Valued as one whole product.

A. Building Product Disclosure and Optimization, Sourcing of Raw Materials: Option 2. Provide products that meet at least one of the below listed criteria for at least 25%, by cost, of the total value of permanently-installed building products in the project:
1. Recycled content: Reported as the sum of postconsumer recycled content plus one-half the preconsumer recycled content, based on cost.
2. Wood products: Must be FSC certified or USGBC-approved equivalent.
3. Bio-based materials: Must meet the Sustainable Agriculture Network’s Sustainable Agriculture Standard.
4. Materials reuse: Reuse includes salvaged, refurbished, or reused products.
5. Regional materials: Products sourced (extracted/harvested and manufactured) from within 100 miles of the project site.

A. Building Product Disclosure and Optimization, Material Ingredients: Option 1. Provide at least 20 permanently installed products (sourced from at least 5 different manufacturers) which meet one of the following disclosure criteria:
   1. Health Product Declaration (HPD).
   2. Cradle to Cradle v2 "Basic Level" or Cradle to Cradle v3.
   3. Declare product label.
   4. ANSI/BIFMA e3 Furniture Sustainability Standard
   5. Cradle to Cradle material health Certificate
   6. Product Lens Certification

B. Low-Emitting Materials, General Emissions Requirements: Products must demonstrate they have been tested and determined compliant in accordance with California Department of Public Health, (CDHP), Standard Method v1.1-2010, using the applicable exposure scenario. Manufacturer's documentation demonstrating compliance must state the range of total VOCs (TVOC) after 14 days, measured as specified in the CDPH Standard Method v1.1 as follows:
   0.5mg/m3 or less
   Between 0.5 and 5.0 mg/m3
   OR
   0.50 mg/m3 or more

C. Low-Emitting Materials, Paints and Coatings: Paints and Coatings applied inside the building waterproofing system must meet the following standards:
   1. CDPH Standard Method v1.1-2010
   2. VOC content: South Coast Air Quality Management District Rule 1113, Architectural Coatings, effective June 3, 2011, (see the table below)

Table 5: South Coast Rule #1133 VOC Limits for Architectural Coatings

Applications	VOC Limit (g/L)	Applications	VOC Limit (g/L)
Bond Breaker	350	Magnesite Cement Coatings	450
Clear Wood Finish – Varnish	275	Mastic Coatings	100
Clear Wood Finish – Sanding Sealer	275	Metallic Pigmented Coatings	150
Clear Wood Finish – Lacquer	275	Multi-Color Coatings	250
Colorant – Arch. Coating, excluding IM Coatings	275	Non-Flat Coatings	50
Colorant – Solvent Based IM	600	Pre-Treatment Wash Primers	420
Concrete – Curing Compounds	100	Primers, Sealers and Undercoats	100
Concrete – Curing Compounds for Roadways and Bridges	350	Reactive Penetrating Sealers	350
Concrete Surface Retarder	50	Recycled Coatings	250
Driveway Sealer	50	Roof Coatings	50
Dry-Fog Coatings	50	Roof Coatings, Aluminum	100
Faux Finishing Coatings – Clear Topcoat	100	Roof Primers, Bituminous	350
Faux Finishing Coatings – Decorative Coatings	350	Rust Preventative Coatings	50
Faux Finishing Coatings - Glazes	350	Stone Consolidator	450
Faux Finishing Coatings – Japan	350	Sacrificial Anti-Graffiti Coatings	50
Faux Finishing Coatings – Trowel Applied Coatings	50	Shellac – Clear	730
Fire-Proof Coatings	150	Shellac – Pigmented	550
Flats	50	Specialty Primers	100

Floor Coatings	50	Stains	100
Form Release Compounds	100	Stains – Interior	250
Graphic Arts (Sign) Coatings	150	Swimming Pool Coatings – Repair	340
Industrial Maintenance Coatings	100	Swimming Pool Coatings – Other	340
Low-Solid Coatings	120	Traffic Coatings	100
Industrial Maintenance Coatings – Non-Sacrificial Anti-Graffiti Coatings	100	Waterproofing Sealers	100
Industrial Maintenance Coatings – Zinc Rich IM Primers	100	Waterproofing Concrete Masonry Sealers	100
Industrial Maintenance Coatings – High Temp. IM Coatings	420	Wood Preservatives	350

D. Low-Emitting Materials, Floor coverings: Comply with CDPH Standard Method v1.1-2010.

E. Low-Emitting Materials, Composite Wood and Agrifiber Binders: Composite wood, agrifiber products, and adhesives shall be made using ultra-low-emitting formaldehyde (ULEF) resins as defined in the California Air Resources Board's "Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products" or shall be made with no added formaldehyde.

F. Additional Low-Emitting Requirements:
1. If the applicable regulation requires subtraction of exempt compounds, any content of intentionally added exempt compounds larger than 1% weight by mass (total exempt compounds) must be disclosed.
2. If a product cannot reasonably be tested as specified above, testing of VOC content must comply with ASTM D2369-10; ISO 11890, part 1; ASTM D6886-03; or ISO 11890-2.
3. Methylene chloride and perchloroethylene may not be intentionally added in paints, coatings, adhesives, or sealants.

G. Indoor Water Use Reduction, Appliances: Provide ENERGY STAR or performance equivalent appliances.

H. Indoor Water Use Reduction, Plumbing Fixtures:
1. Do not exceed water flow requirements indicated in Division 22 – PLUMBING
2. Water Closets, Urinals, Private Lavatory Faucets, and Showerheads are required to be WaterSense labeled.

PART 3 - EXECUTION

3.1 NON-SMOKING BUILDING

A. Tobacco use is not permitted within the building or within 25 feet (8 m) of entrances, operable windows, or outdoor-air intakes during construction.
1. Refer to Section 01 51 50, "Construction Indoor Air Quality".

3.2 CONSTRUCTION WASTE MANAGEMENT

A. Construction and Demolition Waste Management: Comply with Section 01 57 10 "Construction Waste Management".

3.3 CONSTRUCTION INDOOR-AIR-QUALITY MANAGEMENT

A. Construction Indoor Air Quality Management Plan: Comply with Section 01 51 50, "Construction Indoor Air Quality".

END OF SECTION

SECTION 01 91 00 - COMMISSIONING

PART 1 GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing commissioning of building systems, subsystems and equipment including:
1. HVAC components and equipment.
2. Building automation systems.
3. Lighting control systems.
4. Comply with sustainable design requirements for the level indicated in the materials check list.

C. Cooperation: Cooperate with the Owner's commissioning consultants, if any, including attendance at commissioning meetings and activities, coordinating scheduling, access to the work and utility services for commissioning activities.

D. Access: Provide access to project documentation, shop drawings, wiring diagrams, operations and maintenance manuals and similar items when requested by the Owner's commissioning agent.

E. Remedial Work: Modify, adjust, balance, repair or replace systems, subsystems and equipment which do not perform to code requirements or to requirements specified in the Contract Documents at no additional expense to the Owner. Pay for retesting and additional modifications until satisfactory results are obtained.

1.2 DEFINITIONS

A. BoD: Basis of Design. A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.

B. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

C. CxA: Commissioning Authority.

D. OPR: Owner's Project Requirements. A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

E. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.3 COMMISSIONING TEAM

A. Members Appointed by Contractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, representatives of each Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members Appointed by Owner:
1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.
2. Representatives of the facility user and operation and maintenance personnel.
3. Architect and engineering design professionals.

1.4 OWNER'S RESPONSIBILITIES

A. Provide the OPR documentation to the CxA and each Contractor for information and use.

B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.

C. Provide the BoD documentation, prepared by Architect and approved by Owner, to the CxA and each Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

1.5 EACH CONTRACTOR'S RESPONSIBILITIES

A. Each Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
   1. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
   2. Cooperate with the CxA for resolution of issues recorded in the Issues Log.
   3. Attend commissioning team meetings held on a [weekly] [biweekly] [monthly] [variable] <Insert frequency> basis.
   4. Integrate and coordinate commissioning process activities with construction schedule.
   5. Review and accept construction checklists provided by the CxA.
   6. Complete [paper] [electronic] construction checklists as Work is completed and provide to the Commissioning Authority on a [daily] [weekly] <Insert frequency> basis.
   7. Review and accept commissioning process test procedures provided by the Commissioning Authority.
   8. Complete commissioning process test procedures.

1.6 CXA'S RESPONSIBILITIES

A. Organize and lead the commissioning team.

B. Provide commissioning plan.

C. Convene commissioning team meetings.

D. Provide Project-specific construction checklists and commissioning process test procedures.

E. Verify the execution of commissioning process activities using random sampling. The sampling rate may vary from 1 to 100 percent. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the OPR. When a random sample does not meet the requirement, the CxA will report the failure in the Issues Log.

F. Prepare and maintain the Issues Log.

G. Prepare and maintain completed construction checklist log.

H. Witness systems, assemblies, equipment, and component startup.

I. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.

PART 2 PRODUCTS - NOT APPLICABLE TO THIS SECTION

PART 3 EXECUTION - NOT APPLICABLE TO THIS SECTION

END OF SECTION

SECTION 02 22 00 – EXISTING CONDITIONS ASSESSMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section Includes, without limitation, providing:
1. Assessing existing conditions.
2. Reviewing available existing conditions documentation.

C. Existing conditions information:
1. Was collected by Owner and Architect for use in designing the project.
2. Is not part of Contract Documents.
3. Is not guaranteed by Owner nor Architect as complete or accurate.
4. Made available to Contractor solely as a courtesy.
5. Used by the Contractor at their sole risk, liability and judgment.

D. Additional Existing Conditions Information Obtained By Contractor: The Contractor may obtain additional existing condition information and may perform selective exploratory demolition by making a specific written request to the Owner and obtaining his pre-approval.

E. Concealed and Unknown Conditions: Comply with the Conditions of the Contract for Construction. The following conditions are not “concealed” or “unknown” for the purposes of claims:
1. Conditions shown on existing drawings or record drawings or survey drawings.

F. Existing Building Drawings: Where existing buildings are part of the project, existing building drawings may be available for Contractor’s review. Refer to Architect.

PART 2 - PRODUCTS - Not used

PART 3 - EXECUTION – Not used

END OF SECTION

SECTION 02 30 00 - SUBSURFACE INVESTIGATION

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Compliance with subsurface investigation requirements.

1.2 SUBSURFACE INVESTIGATION

A. Information Not Guaranteed: Information on the Drawings and in the Project Manual relating to subsurface conditions, natural phenomena, and existing utilities and structures is from the best sources presently available. Such information is furnished only for the information and convenience of the Contractor, and the accuracy or completeness of this information is not guaranteed.

B. Foundation Engineering Report: Refer to Owner and Architect.

1.3 CONFIRMATION OF GRADES AND UTILITIES

A. Prior to commencement of site excavating operations, the Contractor shall compare existing site grading and proposed new site grading. Where existing utilities are indicated but their inverts or depths are not, exploratory excavating shall be performed to assure that sufficient earth coverage will be attained during the course of new site grading.
1. Utilities existing on the site shall be carefully protected from damage and relocated or removed as required by the work. When an active utility line is exposed during construction, its location and elevation shall be plotted on the record drawings and the Architect, Owner and the utility owner notified in writing.

B. If exploratory excavating confirms that the depth of existing utilities will be negatively impacted by proposed new grades (i.e., will be too shallow or become exposed), immediately notify the Architect and the Owner. Do not proceed with work in such areas until instructions are issued by the Architect. Continue work in other areas.

1.4 CONFIRMATION OF INTEGRITY OF ADJACENT STRUCTURES

A. Prior to commencement of site excavating operations, the Contractor shall compare foundation depths of existing structures and proposed depths of new utilities. Where existing structures are indicated but their foundation depths are not, exploratory excavating shall be performed to assure that proposed new excavations adjacent to them, or in near proximity of them, will not undermine the structural integrity of the existing structures.

B. If exploratory excavating confirms that the footing depths of existing structures may be negatively impacted or undermined by proposed new excavations, immediately notify the Architect and the Owner. Do not proceed with work in such areas until instructions are issued by the Architect. Continue work in other areas.

PART 2 - PRODUCTS [Not Used]

PART 3 - EXECUTION [Not Used]

END OF SECTION

SECTION 02 40 16 – TOTAL STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Demolition and removal of buildings and site improvements.
2. Removing below-grade construction.
3. Disconnecting, capping or sealing, and removing site utilities.
4. Salvaging items for reuse by Owner.
5. Obtaining required permits from utility companies, municipalities and agencies.

1.2 MATERIALS OWNERSHIP

A. 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 INFORMATIONAL SUBMITTALS

A. Submit the following:
1. Schedule of building demolition with starting and ending dates for each activity.
2. Inventory of items to be removed and salvaged.
3. Pre-demolition photographs or video.
4. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician.

B. Project Record Documents: Indicate unanticipated structural, electrical, or mechanical conditions.

C. Proposed Protection Measures: Submit informational 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.

1.4 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Standards: Comply with:
1. ANSI/ASSE A10.6 and NFPA 241.
2. Occupational Safety and Health Standards (29 CFR 1910)
3. Department of Public Health regulations
4. State and local waste specific regulations.

D. Pre-demolition Conference: Conduct conference at Project site.

E. Qualifications: Personnel employed by the contractor to survey or verify the condition of structures shall be competent to determine both the condition of the framing, floors, and walls and the possibility of unplanned collapse of any portion of the structure and shall have the authority to take prompt corrective action when necessary.

1.5 PROJECT 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. Owner assumes no responsibility for buildings and structures to be demolished.
   1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in 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 SOIL MATERIALS

A. Satisfactory Soils: Comply with requirements in Division 31 Earth Moving.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting demolition operations.

B. Inventory and record the condition of items to be removed and salvaged.

C. Perform or 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.

3.2 PREPARATION

A. Refrigerant: Remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction before starting demolition.

B. Existing Utilities: Locate, identify, disconnect, and seal or cap off indicated utilities serving buildings and structures to be demolished.
   1. Arrange to shut off indicated utilities with utility companies.
   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 24 inches (610 mm) 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.

C. 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.

3.3 PROTECTION

A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.

B. Existing Utilities: 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.

C. 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 Division 01 "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.

D. Pollution Controls: Use water sprinkling, temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing regulations pertaining to environmental protection. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.

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.

F. Coordinate demolition schedule with municipal Police and Fire Departments.

G. Promptly notify Police and/or Fire Department of any occurrences, planned or unexpected, requiring their knowledge or assistance.

3.4 DEMOLITION

A. General: Demolish indicated buildings and site improvements completely. Use methods required to complete the Work within limitations of governing regulations.
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 48 hours 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 traffic ways 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. Demolish foundation walls and other below-grade construction within footprint of new construction and extending 5 feet (1.5 m) outside footprint indicated for new construction].
   1. Remove below-grade construction, including basements, foundation walls, and footings, completely.

G. Existing Utilities: Demolish existing utilities and below-grade utility structures within 5 feet (1.5 m) outside footprint indicated for new construction.

H. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations according to backfill requirements in Section 312000 - Earth Moving with one of the following in compliance with drawings and subject to Geotechnical Engineer approval:
   1. Satisfactory soil materials.
   2. Recycled pulverized concrete.
   3. Recycled pulverized masonry.

I. 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.

J. Promptly repair damage to adjacent buildings caused by demolition operations.

3.5 CLEANING

A. Remove demolition waste materials from Project site [and legally dispose of them in an EPA-approved landfill acceptable to authorities having jurisdiction]. See Section 01 57 10 Construction Waste Management for recycling and disposal of demolition waste.

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

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

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. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Footings.
2. Foundation walls.
3. Slabs-on-grade.

B. Related Sections include the following:
1. Division 31 Section "Earth Moving" for drainage fill under slabs-on-grade.
2. Division 07 Section “Under Slab Vapor Barrier”
3. Division 01 Section “Construction Waste Management”

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with fly ash; subject to compliance with requirements.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. Each mix design shall be accompanied by either a standard deviation analysis or trial mixture analysis backup in accordance with ACI 318. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement", and as shown on the drawings. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
1. Shop drawings shall bear the initials of both the detailer and checker for the detailing agency employed by the Contractor to indicate that the said shop drawings have been checked by the shop prior to submission.
2. Any errors, including omissions, coordination, and errors in dimensions shown on the shop drawings shall be the responsibility of the Contractor.

D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.

E. Qualification Data: For testing agency.

F. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates.

G. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Waterstops.
6. Curing compounds.
7. Floor and slab treatments.
8. Bonding agents.
9. Adhesives.
10. Vapor retarders.
11. Semirigid joint filler.
12. Joint-filler strips.
13. Repair materials.

H. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.

I. Field quality-control test and inspection reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, acceptable to Engineer/ Architect qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

E. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."

F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specification for Structural Concrete,"

2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
3. ACI 318-2008, “Building Code Requirements for Structural Concrete.”
4. ACI 347R-2001, “Recommended Practice for Concrete Formwork.”
5. Concrete Reinforcing Steel Institute (CRSI), “Manual of Standard Practice.”
6. ASTM C94-1995, “Specification for Ready-Mixed Concrete.”
7. ASTM C618-1995, Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Uses as a Mineral Admixture in Portland Cement Concrete.
8. ASTM C311-1995, Standard Methods of Sampling and Testing Fly Ash and Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

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 Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.
3. 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.
4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
   a. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 60 percent.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

D. Plain-Steel Wire: ASTM A 82, as drawn.

E. Deformed-Steel Wire: ASTM A 496.

F. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut bars true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.5 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I/II , . Supplement with the following:

a. Fly Ash: ASTM C 618, Class F

2. Brand of cement shall not be changed during progress of job unless approved in writing by Engineer/Architect.

3. The cement shall not contain any ingredients as shown by cement mill certificates which would cause more than 3 percent air to be entrained in the concrete when cement is used in the concrete mix.

4. Cement shall be stored in such a manner as to prevent deterioration or intrusion of foreign matter.

5. No foreign cement (non-domestic cement) shall be permitted in concrete.

B. Normal-Weight Aggregates: ASTM C 33, Class Severe weathering region, but not less than 4S coarse aggregate or better, graded. Provide aggregates from a single source. Provide uniformly graded aggregate and the maximum size of coarse aggregate shall not exceed one-fifth of minimum dimension between forms of member for which concrete is to be used, three-fourths of minimum clear spacing between reinforcing bars or 1 inch, whichever is smaller.

1. Maximum Coarse-Aggregate Size: 1-1/2 inches (38 mm) for footings, 3/4 inch (19 mm) nominal for slabs.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M and potable.

2.6 ADMIXTURES

A. General: No admixture shall be used in concrete unless specified herein, except with the permission of the Engineer/Architect. No changes of admixtures shall be made after design mix approval. Contractor shall provide the services (including any expenses) of the admixture manufacturer's representative to assure proper use of admixtures.

1. Prohibited Admixtures: Only the specified non-corrosive, non-chloride, noncorrosive accelerator shall be used. Calcium chloride, thiocynates, or admixtures containing more than 0.05 percent chloride ions are not permitted.

2. Certification: Written conformance to the above-mentioned requirements and the chloride ion content of the admixture is required from the admixture manufacturer prior to mix design review by the Engineer/Architect.

B. Air-Entraining Admixture: ASTM C260, certified by manufacturer to be compatible with other required admixtures.

1. Products: Subject to compliance with requirements, provide one of the following:

a. "Air-Mix" or "AEA-92"; Euclid Chemical Company
b. "Sika Aer"; Sika Corporation
c. "MB AE 90" or "Micro-Air"; Master Builders
d. “Daravair –1000” or "Darex II"; W. R. Grace & Co.
e. or equal

C. Water-Reducing Admixture: ASTM C494, Type A, and containing not more than 0.05 percent chloride ions.

1. Water-Reducing Admixture: ASTM C494, Type A, and containing not more than 0.05 percent chloride ions.

a. "WRDA with Hycol"; W. R. Grace & Co.
b. "Eucon WR-75" or "Eucon WR-89"; Euclid Chemical Company
c. "Plastocrete 161"; Sika Chemical Corporation
d. "Polyheed 997" or "Pozzolith 220-N"; Master Builders.
e. or equal

D. High-Range Water-Reducing Admixture (Super Plasticizer): ASTM C494, Type F or Type G and containing not more than 0.05 percent chloride ions.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. "Sikament - 300"; Sika Chemical Corporation
    b. "Eucon 37"; Euclid Chemical Company
    c. "Daracem-100" or "WRDA-19"; W. R. Grace & Co.
    d. "Rheobuild 1000"; Master Builders.
    e. or equal

E. Water-Reducing, Non-Corrosive, Non-Chloride Accelerator Admixture: ASTM C494, Type C or E, and containing not more than 0.05 percent chloride ions. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year's duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. "Accelguard 80"; Euclid Chemical Co.
    b. "Polarset"; W. R. Grace & Co.
    c. "Pozzutec 20" or "Pozzolith NC-534"; Master Builders
    d. “Plastocrete 161FL”; Sika Chemical Corporation
    e. or equal

F. Water-Reducing, Retarding Admixture: ASTM C 494, Type D, and containing not more than 0.05 percent chloride ions.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. "Eucon Retarder 75"; Euclid Chemical Co.
    b. "Daratard 17"; W.R. Grace & Co.
    c. "Plastocrete 161R"; Sika Chemical Co.
    d. "Pozzolith 122R"; Master Builders.
    e. or equal

2.7 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. (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating.

1. Products:
    a. Dayton Superior Corporation; Safe Cure and Seal (J-19).
    b. Euclid Chemical Company (The); Diamond Clear VOX.
    c. L&M Construction Chemicals, Inc.; Dress & Seal WB.

d. or equal

F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. Products:
   a. Euclid Chemical Company (The); Super Diamond Clear VOX.
   b. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
   c. Meadows, W. R., Inc.; Vocomp-30.
   d. or equal

2.8 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber .

B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

C. Reglets: Fabricate reglets of not less than 0.0217-inch- (0.55-mm-) thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

D. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.9 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) 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 (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.10 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, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Use fly ash, as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 25 percent. Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15] percent by weight of cement.

D. Admixtures: Use admixtures according to 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 materials ratio below 0.50.
4. All concrete slabs placed at temperatures below 50 degrees F shall contain the specified non-corrosive, non-chloride accelerator.
5. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings & Exterior Slabs: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4500 psi at 28 days.
2. Minimum Cementitious Materials Content: 600 lb/cu. yd.
3. Maximum Water-Cementitious Materials Ratio: 0.44.
4. Slump Limit: Not less than 1” and not more than 4”
5. Air Content: All concrete exposed to freezing and thawing, deicer chemicals and/or required to be watertight or subjected to hydraulic pressure or soil shall have an air content of 5.5% to 8%.

B. Interior Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Minimum Cementitious Materials Content: 570 lb/cu. yd.
3. Maximum Water-Cementitious Materials Ratio: 0.47 Interior slabs, 0.44 exterior slabs.
4. Slump Limit: 3 inches.
5. Air Content: All concrete exposed to freezing and thawing, deicer chemicals and/or required to be watertight or subjected to hydraulic pressure or soil shall have an air content of 5.5% to 8%. .
6. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.

2.12 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.13 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

2. Delete the reference for allowing additional water to be added to the batch for material with insufficient slump. Addition of water to the batch will not be permitted.

3. Provide batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of water introduced, cement content and admixture used.

B. Project-Site Mixing: Project-Site Mixing shall not be permitted without approval from the engineer.

PART 3 - EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT

A. The contractor, subcontractors, and their personnel shall follow the procedures and practices for waste separation, collection and transport as defined in the contractor's "Waste Management Plan" as required by Division 01 Section "Construction Waste Management."

3.2 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. The design and engineering of formwork, as well as its construction, shall be the responsibility of the Contractor. It shall be the Contractor's total responsibility to insure safety to workmen, public and for the total structure at all times. The Contractor shall be responsible to use firm unyielding supports and provide adjustable devices for setting, wedging, and lending the finished forms in correct alignment and position with all work in conformity with governing building code requirements and these specifications. The Contractor shall be responsible to pay for all costs connected with design of this work (forms, shores, etc.), checking same and certification to Engineer/Architect and Building Department. Such form design shall be performed by a professional engineer licensed in the state of the project and experienced in such form design. When the load on the shores exceeds 150 pounds per square foot, or power buggies are used, the Contractor shall certify that the form, shore, and bracing design has been checked and approved by a professional engineer licensed in the state of the project with at least five (5) years experience and installation of this work has been done in conformity with the approved design. The design, tolerance of finished lines and camber to compensate for deflection due to weight of fresh concrete shall conform to ACI-347, "Guide to Formwork for Concrete." Construct forms to slopes, lines and dimensions shown, plumb and straight and sufficiently tight to prevent leakage, securely brace and shore forms to prevent displacement and to safely support construction loads. Provide access openings for cleaning and inspecting forms and reinforcing.

C. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

D. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
2. Class C, 1/2 inch (13 mm) for rough-formed finished surfaces.

E. Construct forms tight enough to prevent loss of concrete mortar.

F. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. 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. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

I. Chamfer exterior corners and edges of permanently exposed concrete.

J. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

K. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

L. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

M. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.3 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. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
2. 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. Install dovetail anchor slots in concrete structures as indicated.
4. Conduits and pipes embedded in concrete slabs, beams and walls shall be in accordance with ACI Building Code requirements, latest edition, and as herein specified. Where there are banks of conduits or pipes in slabs, 6" x 6" - #6 mesh shall be placed under or over these banks of conduits or pipes and run beyond each side at least 12 inches. Extra reinforcement shall be installed as per Engineer/Architect's or his representative's directions for conduits and pipes, penetrating walls, etc. Any conduit or bank of conduits or pipes which impair the structural strength of the structural element involved shall not be permitted. No conduit and/or pipe shall be tied parallel to the reinforcing bar which would reduce bond of same reinforcing bar. No aluminum conduit and/or pipe shall be allowed to be embedded in concrete. Where there are expansion joints, proper conduit or pipe expansion sleeves shall be installed to allow proper freedom of movement. No conduits shall be placed to run through columns, including the slab or beams within the area of any column. Conduit in structural slab shall be permitted only for home runs and branch conduit work for fixtures in exposed ceilings areas. In rib construction, any cross or conduits within the floor slab shall occur at the ribs with crossing conduit dropping into rib. At no point shall the concrete covering be less than 3/4 inch.

3.4 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.

2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.5 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. 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 would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

F. After substantial delay in the work previously started, reinforcing steel shall be inspected and cleaned free from mortar prior to proceeding with the work.

G. No concrete placement shall be allowed when, in Engineer/Architect's opinion, insufficient time is provided to review and correct misplaced reinforcing steel.

H. Bends or hooks unless otherwise shown or required shall be cold formed around pins. Hooks shall be ACI Standard.

3.6 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
3. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
4. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
5. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

6. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Sawed Joints: Form contraction joints with a “Soff-Cut Saw” equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: 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. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
3. 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: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

F. Unless otherwise noted, the, maximum spacing of construction and/or contraction joints shall be as follows:
1. Slabs on grade: 15’

3.7 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. 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.

E. 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. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

F. Unless otherwise provided, concrete footings and exterior slab and foundations shall be placed directly on undisturbed or structurally compacted backfill surfaces that are thoroughly moistened but not muddy at time concrete is placed. There shall be no free water present at footing bottoms between time of final excavation to grade and concrete placement.

G. Where established bottoms of footings for bearing as shown on drawings have not been maintained or have been disturbed, all loose material shall be removed to good bottom and the footings may be placed at the lower level with increase in length of vertical reinforcement required to reach the lowered footing or a plain concrete pad may be placed up to the former level of bottom of footing.

H. Concrete shall not be allowed to drop freely where reinforcing will cause segregation nor shall it be dropped freely more than ten (10) feet for concrete containing the high range water reducing admixture (superplasticizer) or five (5) feet for other concrete

I. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures. It shall be the Contractor's complete responsibility to place and maintain concrete at the specified minimum internal temperature of at least 50° F, for as long as necessary to assure proper strength for safety, stripping and obtaining design strengths with non-excessive deflections. Cold weather requirements regarding class of protection, time period of heat, enclosures, coverings, etc., shall be as required to accomplish the above. When atmospheric temperatures are predicted to fall below 30 deg F, the Contractor shall obtain approval to pour from Engineer/Architect. Class of concrete protection and Contractor's ability to meet all Specification requirements shall determine approval or non-approval.

1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

J. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.8 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.9 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: After placing slabs, plane surface to tolerances for floor flatness (FF) of 20 and floor levelness (FL) of 15. Slope surfaces uniformly to drains where required. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch (6 mm) in 1 direction.

1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture. Check and level surface plane to tolerances of FF 23/FL 17. Uniformly slope surfaces to drains. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces indicated to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces indicated and 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.
2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:
   a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
   b. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs.

3. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-foot- (3.05-m-) long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 3/16 inch (4.8 mm)

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

G. Slip-Resistive Finish: Before final floating, apply slip-resistive aggregate finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:

1. Uniformly spread 25 lb/100 sq. ft. (12 kg/10 sq. m) of dampened slip-resistive aggregate over surface in 1 or 2 applications. Tamp aggregate flush with surface, but do not force below surface.
2. After broadcasting and tamping, apply float finish.
3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate.

3.10 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. 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: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

D. Grout base plates and bearing plates as indicated, using specified non-shrink non-metallic grout. Where high fluidity and/or increased placing time is required use the specified high flow grout. This grout shall be used for all base plates larger than 10 sq. ft.

E. Reinforced Masonry: Provide concrete grout for reinforced masonry, lintels and bond beams where indicated on drawings and as scheduled. Maintain accurate location of reinforcing steel during concrete placement.

3.11 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

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 (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
   c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

   a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.12 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least [**one**] [**six**] month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.13 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension in solid concrete, but not less than 1 inch (25 mm) in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.14 FIELD QUALITY CONTROL

A. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

B. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; 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. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M.

    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
    a. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
7. 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 (3.4 MPa).
8. Test results shall be reported in writing to Architect, 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 inspecting 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 both 7- and 28-day tests.
9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
10. Additional Tests: 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 Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate dos not comply with the Contract Documents.

C. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 48 hours of finishing.

END OF SECTION 03 30 00

SECTION 04 22 21 – REINFORCED CONCRETE MASONRY ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section Includes, without limitation, providing:
1. Concrete masonry units.
2. Reinforcing, ties and anchors.
3. Mortar & grout.
4. Miscellaneous masonry accessories.

C. Related Sections:
1. Division 04 00 00 – Other masonry assemblies and work
2. Division 07 00 00 - Flashings

1.2 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.
2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C 1314.

B. PRECONSTRUCTION TESTING

C. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
1. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.
2. Mortar Test (Property Specification): For each mix required, according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content].
3. Mortar Test (Property Specification): For each mix required, according to ASTM C 780 for compressive strength.
4. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.
5. Prism Test: For each type of construction required, according to ASTM C 1314.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For the following:
1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: .
4. Samples for Verification: For each type and color of the following:

C. Qualification Data: For testing agency.

D. Material Certificates: For each type and size of the following:
1. Masonry units.
   a. Include data on material properties.
   b. For masonry units include data and calculations establishing average net-area compressive strength of units.

E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

F. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

G. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

C. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

D. Sample Panels: Provide only if requested.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.6 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. 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 ACI 530.1/ASCE 6/TMS 602.
1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.
1. CMU in walls with hourly fire ratings shall be certified and UL classified and stamped to meet wall rating. Provide the appropriate class rating depending upon wall classification.
    a. For 2 hour walls, provide certified stamped D-2 CMU.
    b. Separate storage and deliveries of differently rated CMU.

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, bond beams, and other special conditions.
2. Provide square-edged units for outside corners unless otherwise indicated.

B. CMUs: ASTM C 90.
1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi.
2. Density Classification: As shown, if not, normal weight.
3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
4. Exposed Faces: Provide color and texture matching the range represented by Architect's selected and approved sample.

C. Concrete Building Brick: ASTM C 55.
1. Unit Compressive Strength: 2500 psi or more. Provide units with minimum average net-area compressive strength of 2800 psi or more.

2.3 CONCRETE AND MASONRY LINTELS

A. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than CMUs.

B. General: Provide one of the following:

C. Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in Division 3 Section "Cast-in-Place Concrete," and with reinforcing bars indicated.

D. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.4 MORTAR AND GROUT MATERIALS

A. Concrete masonry block walls – Mortar type: S

B. Provide the following materials:
1. Portland Cement: ASTM C 150, Type I or II low alkali type, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
2. Hydrated Lime: ASTM C 207, Type S.
3. Aggregate for Mortar: ASTM C 144.
    a. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
    b. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.

4. Water: Potable.
5. Aggregate for Grout: ASTM C 404.

C. Grout for Unit Masonry: Comply with ASTM C 476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, Table 1 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump as measured according to ASTM C 143/C 143M, as follows:
   a. As shown on structural drawings, if not, 8 to 11 inches.

2.5 REINFORCEMENT & WIRE SIZES

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
1. Interior Walls: As shown, if not, hot-dip galvanized, carbon steel.
2. Exterior Walls: As show, if not hot-dip galvanized, carbon steel or stainless steel.
3. Wire Size for Side Rods: 0.1875 inch. diameter.
4. Wire Size for Cross Rods: 0.187-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: Either ladder or truss type with single pair of side rods.

2.6 TIES AND ANCHOR MATERIALS

A. 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 A 82/A 82M; with ASTM A 153/A 153M, Class B-1 coating, except provide 2.0 ounce/sq.ft. or m ore on wires of all diameters.
2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304. Use Type 316 within 5 miles of oceanfront. Confirm with Architect other environments are not considered corrosive.
3. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
4. Stainless-Steel Sheet: ASTM A 666, Type 304. Use Type 316 as indicated for SS wire.
5. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.7 MISCELLANEOUS ANCHORS

A. Partition Top anchors:
1. 0.105-inch thick metal plate with 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 or stainless steel.

B. 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 or bent to configuration shown.
1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.

C. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.
1. Load Capacity: 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 E 488, conducted by a qualified independent testing agency.
2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or , Class Fe/Zn 5 unless otherwise indicated.
3. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Type 304 stainless-steel bolts, , and nuts, .

2.8 EMBEDDED FLASHING MATERIALS

A. Refer to section called "Flashing Built into walls."

2.9 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805] 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, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Build chases and recesses to accommodate items specified in this and other Sections.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

C. 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.

3.3 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.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 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 exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.4 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] [bond pattern indicated on Drawings]; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches]. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

H. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
1. Install compressible filler in joint between top of partition and underside of structure above.
2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch (13-mm) clearance between end of anchor rod and end of tube. Space anchors [48 inches (1200 mm)] <Insert spacing> o.c. unless otherwise indicated.
3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Division 7 Section "Fire-Resistive Joint Systems."

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:
1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.

4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid 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.

C. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
2. Allow cleaned surfaces to dry before setting.
3. Wet joint surfaces thoroughly before applying mortar.

D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.6 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
1. Space reinforcement not more than 16 inches (406 mm) o.c.
2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) 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.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at[corners,] returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 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 (13 mm)] [1 inch (25 mm)] [2 inches (50 mm)] 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 (610 mm) o.c. vertically and 36 inches (915 mm) o.c. horizontally.

3.8 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry [as follows] [using one of the following methods]:
1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
2. Install preformed control-joint gaskets designed to fit standard sash block.
3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

3.9 LINTELS

A. Provide concrete or masonry lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.

B. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

3.10 FLASHING

A. Refer to section titled "Flashing built into walls."

B. General: Install embedded flashing in masonry at lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

C. 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 lintels, extend flashing a minimum of into masonry at each end. At heads and sills, extend flashing at ends and turn up not less than to form end dams.
3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Division 7 Section "Joint Sealants" for application indicated.
4. Install metal [drip edges] [and] [sealant stops] with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Division 7 Section "Joint Sealants" for application indicated.
5. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing back from outside face of wall and adhere flexible flashing to top of metal drip edge.
6. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
7. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

D. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

E. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

3.11 REINFORCED UNIT MASONRY INSTALLATION

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 other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

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 ACI 530.1/ASCE 6/TMS 602 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. .

3.12 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 meet specified requirements shall be done at Contractor's expense.
1. Inspections: Level 1 special inspections according to the "International Building Code."
2. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
3. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
4. Place grout only after inspectors have verified proportions of site-prepared grout.
5. Testing Prior to Construction: One set of tests.
6. Testing Frequency: One set of tests for each of wall area or portion thereof.

B. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
1. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

C. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.

D. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

E. Prism Test: For each type of construction provided, according to ASTM C 1314 at 7 days and at 28 days.

3.13 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. 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. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.14 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. 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. Crush masonry waste to less than 4 inches (100 mm) in each dimension.
2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Division 2 Section "Earthwork."
3. Do not dispose of masonry waste as fill within 18 inches (450 mm) of finished grade.

C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

SECTION 04 22 50 - ARCHITECTURAL CONCRETE MASONRY UNITS

PART 1 GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section

B. Section includes, without limitation, providing:
1. Architectural concrete masonry unit construction.
2. Ground face CMU.

C. Extent: Decorative faced or finished architectural concrete masonry units.

D. Related work includes, without limitation:
Division 04 00 00 – Other masonry assemblies and work
Division 07 00 00 - Flashings
Section 04 80 11 – Masonry assemblies & accessories:

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
1. Shop drawings shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.

C. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.

D. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Fire Performance for Fire-Rated Brick and Concrete Block Assemblies: ASTM E 119.
1. CMU in walls with hourly fire ratings shall be certified and UL classified and stamped to meet wall rating. Provide the appropriate class rating depending upon wall classification.
   a. For 2 hour walls, provide certified stamped D-2 CMU.
   b. Separate storage and deliveries of differently rated CMU.

B. Testing: Independent Testing Laboratory.

C. Mock-Ups: Provide mock-up as required to demonstrate quality of workmanship.

D. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 GROUND FACE & POLISHED UNITS

A. Architectural Concrete Masonry Units:
1. Manufacturers: Subject to compliance with specifications,
   a. Jandris & Sons.
   b. Westbrook Concrete Block.
   c. Anchor Concrete Products.
   d. Approved equal.
2. Application: Where shown.

3. Concrete Masonry Units: ASTM C 90, 1500 f'm compressive strength:
   a. Normal weight.
4. Size: Face dimension of 7-5/8 inches high by 15-5/8 inches long by width required for application.
5. Special Finish: Standard aggregate, ground finish.
   a. Acceptable product: Jandris Architectural CMU ground face masonry units and polished masonry units
   b. Acceptable product: Trendstone® ground face masonry units Trendstone Plus® filled and polished masonry units
6. Special Shapes: As required by building configuration.
7. Bond Pattern: As shown, if not, Running Bond.
8. Integral Water Repellent: Liquid polymeric admixture.

2.2 RELATED MATERIALS & COMPONENTS

A. Mortar and Grout for Concrete Masonry Unit Assemblies: Comply with the following:
1. Mortar Mix: ASTM C 270, Type S, for reinforced masonry, masonry below grade and masonry in contact with earth and ASTM C 270, Type N, for above-grade loadbearing and nonloadbearing walls and parapet walls and for interior loadbearing and nonloadbearing partitions.
2. Mortar Materials: Portland cement, ASTM C 150, Type I or II.
3. Mortar Materials: Masonry cement, ASTM C 91: Not permitted unless entrained air is 10% or less.
4. Mortar Aggregate: Natural color, ASTM C 144.
5. Grout Aggregate: ASTM C 404.
6. Hydrated Lime: ASTM C 207, Type S.
7. Color: Colored pigmented mortar where exposed at building exterior and natural color elsewhere.

B. Trim units: Matching units manufactured by architectural CMU fabricator. , if not, provide matching precast units per Section 03 45 00.

C. Reinforcing Steel:
1. Reinforcing Bars: ASTM A 615, Grade 60.
2. Deformed Reinforcing Wire: ASTM A 496.
3. Welded Wire Fabric: ASTM A 497, deformed.

D. Reinforcing:
1. Welded wire with deformed side rods.
2. Steel Wire: 9 gauge (.1875 inch) galvanized steel.
3. Type: Ladder or truss type.

E. Ties and Anchors:
1. Bent Wire Ties: Galvanized steel.
2. Rigid Anchors: Galvanized steel straps.
3. Masonry to Concrete Frame: Two-piece galvanized steel anchor.
4. Masonry to Steel Frame: Anchor with crimped wire anchor section for welding to steel.
5. Adjustable Masonry Veneer Anchors: Screw-attached two-piece galvanized triangular or rectangular wire tie and metal anchor.
6. Screws for Steel Studs: ASTM C 954 organic polymer coated steel drill screws.
7. Unit Type Masonry Inserts in Concrete: Malleable iron.
8. Dovetail Slots: Galvanized sheet metal.
9. Anchor Bolts: ASTM A 307, Grade A, galvanized.
10. Post-installed Anchors: Chemical or expansion anchors.

F. Masonry Accessories:
1. Cavity Drainage Material.
2. Flashing: Rubberized-Asphalt or EPDM Flashing with stainless steel drip edge.
3. Flashing: Stainless steel or copper-laminated flashing.
4. Loose-Granular Fill Insulation.
5. Nonmetallic expansion joint strips.
6. Preformed control joint gaskets.
7. Bond breaker strips.
8. Weeps: Plastic tubing.

9. Cavity vents.

PART 3 EXECUTION

3.1 INSTALLATION

A. Installation of Masonry Assemblies: Comply Section 04 80 11, with manufacturers recommendations and the following:
1. Comply with PCA Recommended Practices for Laying Concrete Block, and NCMA TEK Bulletins.
2. Comply with cold weather and warm weather protection procedures as recommended in BIA Tech Notes.
3. Provide fire-rated assemblies complying with ASTM E 119.
4. Saw cut units when required. Maintain uniform joint width. Provide full bed, head and collar joints except at weepholes.
5. Do not rake out joints unless approved in writing by Architect and manufacturer.
6. Install lintels and accessories in masonry construction.
7. Coordinate installation of flashings.
8. Comply with applicable codes and regulations for spacing of ties and horizontal reinforcing.
9. Provide expansion and control joints in accordance with BIA and NCMA recommendations.
10. Remove and replace damaged units.
11. Clean concrete masonry by dry brushing, NCMA TEK No. 28.

END OF SECTION

SECTION 04 72 00 - CAST STONE MASONRY

PART 1 GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Provide cast stone fabrications, including:
1. Cast stone masonry.
2. Mortar.
3. Reinforcement, anchorages and accessories.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used. Include LEED submittals.

B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
1. Shop drawings shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.

C. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Standard: Manufacturer is a producing member of the Cast Stone Institute or has on file and follows a written quality-control plan that includes all elements of the Cast Stone Institute's "Quality Control Procedures Required for Plant Inspection."

C. Testing: Independent testing laboratory.

D. Mock-Ups: Provide mock-up as required to demonstrate quality of workmanship.
1. Full-size typical unit, with complete assembly including back up substrate, flashing, mortar, caulking and the like.

PART 2 PRODUCTS

2.1 GENERAL

A. Cast Stone Applications:
1. Manufacturers shall have active membership in Cast Stone Institute or Architectural Precast Association.
2. Application: As shown.

2.2 BELOW GRADE USE

A. Where below grade use is required, manufacturer shall certify product is suitable for below grade use when bituminous dampproofing is applied.

2.3 MATERIALS

A. Cast stone units:
1. Performance and design of units at 28 days; comply with ASTM C1364.
2. Casting method: As required to achieve appearance and performance specified.

3. Compressive strength: 6500 psi minimum, per ASTM C1194.
4. Air Content: 4 to 6 percent, ASTM C173 OR C231.
5. Water absorption: Maximum 6 percent, cold water method, ASTM C1195.
6. Density: Not less than 120 pounds per cubic foot.
7. Linear Shrinkage, ASTM C 426: Less than .065 percent.
8. Freeze-Thaw, ASTM C 666: Less than 5 percent cumulative mass loss after 300 cycles.

B. Curing: Cure in enclosed chamber at 100 percent relative humidity and minimum 90 degrees F for up to 16 hours and yard cure for a minimum of 3 days.

C. Shape:
1. Bed depth: As shown.
2. Sizes: As scheduled or indicated on drawings.
3. Special shapes: Provide special shapes required including watertables, sills, and the like.
4. Provide returns and finished ends.

D. Defect Limits:
1. Holes, Pockets Voids:
   a. Face size – 0.0325 inch maximum face dimension.
   b. Depth – 0.06 maximum depth from face plane.
   c. Quantity – 3 permissible defects per square inch.
2. Cracks: None permitted any size or length.
3. Stains, discolorations: None permitted.
4. Visible reinforcing steel: None permitted.
5. Edge & Corner chips: None permitted any size or length.
6. Mix: Provide face mix consistently through units

B. Concrete Materials:
1. Portland cement: Portland cement, ASTM C 150, Type I.
2. Fine Aggregate for Facing Mixes: ASTM C 33 and colors as needed to produce required cast stone colors.
3. Coarse Aggregate: Granite, quartz, or limestone complying with ASTM C 33; gradation as needed to produce required textures and colors as needed to produce required cast stone colors.
4. Pigments: ASTM C 979, synthetic mineral-oxide pigments, color stable, nonfading, and resistant to lime and other alkalis.

C. Concrete Admixtures:
1. Chloride Content: Containing less than 0.1 percent chloride ions.
2. Air-Entraining Admixture: ASTM C 260.
3. Water-Reducing Admixture: ASTM C 494, Type A.
4. Water-Reducing, Retarding Admixture: ASTM C 494, Type D.
5. Water-Reducing, Accelerating Admixture: ASTM C 494, Type E.

D. Reinforcement:
1. Dowels: Not less than 0.50 inch, Type 304 Stainless steel per ASTM A276.
2. Steel Bars: Deformed steel bars complying with ASTM A 615; galvanized or epoxy-coated reinforcement when covered with less than 1-1/2 inches of cast stone material.
3. Epoxy Coating: ASTM A 775.
4. Galvanized Coating: ASTM A 767.

E. Embedded Anchors and Inserts:
1. Stainless Steel: ASTM A 240, Type 304.
2. Steel: ASTM A 36 and hot-dip galvanized: ASTM A 123.

F. Mortar and Grout:
1. Mortar Mix: ASTM C 270, Type S, for reinforced masonry, masonry below grade and masonry in contact with earth and ASTM C 270, Type N, for above-grade loadbearing and nonloadbearing walls and parapet walls and for interior loadbearing and nonloadbearing partitions.
2. Mortar Materials: Portland cement, ASTM C 150, Type I or II.

3. Mortar Aggregate: Natural color, ASTM C 144.
4. Grout Aggregate: ASTM C 404.
5. Hydrated Lime: ASTM C 207, Type S.
6. Color: Colored pigmented mortar where exposed at building exterior and natural color elsewhere.

G. Fabrication Tolerances:
1. Variation in Cross Section: Do not exceed 1/8 inch.
2. Variation in Length: Do not exceed 1/360 of the length of unit or 1/8 inch.
3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch.
4. Location of Grooves or Anchorages: Not greater that 1/8 inch on formed surfaces or 3/8 inch on unformed surfaces.
5. Horizontal surfaces: As shown, if not, 1:12 slope to drain away from structure.

H. Colors and textures: As determined and selected by Architect.

PART 3 EXECUTION

3.1 GENERAL

A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.

B. Replace damaged units. Clean and protect work from damage.

3.2 TOLERANCES

A. Installation Tolerances:
1. Variation from Plumb: Do not exceed 1/8 inch in 5 feet or 1/4 inch in 20 feet or more.
2. Variation from Level: Do not exceed 1/8 inch in 5 feet, 1/4 inch in 20 feet, or 3/8 inch maximum.
3. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch or 1/4 of nominal joint width, whichever is greater.
4. Variation in Plane Between Adjacent Surfaces: Do not exceed 1/8-inch difference between planes of adjacent units or adjacent surfaces indicated to be flush with units.

3.1 EXAMINATION

A. Verify that areas to receive cast stone work are in proper condition and ready to receive work.

B. Determine field conditions by actual measurement.

3.2 PREPARATION

A. Provide for erection procedures and induced loads during erection. Maintain temporary bracing in place until final support is provided.

B. Provide necessary hoisting equipment.

3.3 SETTING

A. All cast stone shall be set by experienced stone masons, accurately and in accordance with the approved shop and setting drawings. Unless otherwise noted, every stone shall be set in a full bed of mortar with all vertical joints flushed full. All anchors and dowels shall be firmly placed and all anchor holes and dowel holes and similar holes filled completely with mortar.

B. When setting with mortar, all stones not thoroughly wet shall be drenched with clear water just prior to setting.

C. After each stone has been set, all joints shall be raked to a depth of 3/4" from the face for pointing. The face of each stone shall then be sponged off to remove any splashed mortar or mortar smears.

D. Only the ends of lugged sills and steps shall be embedded in mortar. The balance of joint shall be left open until pointing of stone work, then tuck pointed on face only to a depth of 3/4".

E. All cornices, copings, projecting belt courses, steps, platforms and, in general, all stone areas either partially or totally horizontal, shall be set with unfilled vertical joints. After setting, insert properly sized back-up material or backer rod to proper depth, prime the ends of the stone, and gun in sealant.

3.4 FIELD QUALITY CONTROL

A. All stone shall be protected from splashing mortar or damage by other trades. Any foreign matter splashed on the stone shall be removed immediately.

B. Erect units without damage to shape or finish. Replace or repair damaged panels.

C. Erect units level and plumb within allowable tolerances.

D. Align and maintain uniform horizontal and vertical joints as erection progresses.

E. When units require adjustment beyond design or tolerance criteria, discontinue affected work; advise Architect.

3.5 PATCHING

A. The repair of chipped or damaged cast stone shall be done only by mechanics skilled in this class of work, with materials furnished by the manufacturer and according to his direction.

B. Cast stone shall show no obvious repairs or imperfections other than minimal color variations when viewed with the unaided eye under good typical lighting at a 20-foot distance.

3.6 CLEANING

A. Before pointing, the face of all cast stone shall be scrubbed with fiber brush, using soap powder and water and shall then be rinsed thoroughly with clean water. Any mortar on the face of the cast stone shall be removed. No acids or prepared cleaners shall be used without the approval of the cast stone manufacturer.

3.7 POINTING

A. When ready for pointing, the joints shall be dampened and carefully pointed to a slight concave unless otherwise specified by the Architect. No pointing shall be done in freezing weather nor in locations exposed to hot sun, unless properly protected.

3.8 PROTECTION

A. Protect units from damage until final acceptance.

END OF SECTION

SECTION 05 08 00 – FACTORY APPLIED METAL COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section Includes, without limitation, providing:
1. Factory applied metal finishes.

C. Extent, without limitation, includes:
1. Aluminum finishes on glazed exterior framing, interior frames, and roofing components and the like.
2. Aluminum components.
3. Where required.

D. Related Sections, without limitation, include factory applied finishes on assemblies in:
1. Section 05 08 50 - Hot Dip Galvanizing
2. Section 05 08 60 - Shop Coatings on Galvanizing
3. Division 07 00 00 – Pre-finished sheet metal components
4. Division 08 00 00 – Prefinished opening and aluminum framing components

1.2 SUBMITTALS

A. Comply with Division 01 General Requirements and submit for approval:
1. Product Data: Manufacturer's literature including installation instructions, use and limitations.
2. Shop drawings: Submit under respective sections. Indicate which finishes used on which application.
3. Initial Selection samples: Under respective sections, provide samples of color and material ranges.
4. Verification: Under respective sections, submit final samples of selected products. Include samples showing full variation of color and finish expected.
5. Maintenance Data: Provide recommended maintenance procedures.
6. Certification: Certify submitted materials comply with requirements.

B. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Comply with Division 01 requirements and governing codes and regulations, and the following:
1. Fabricator/Installer: Shall be a firm which has at least five years experience in work of the type required by this project.
2. Comply with product requirements, delivery storage and handling provisions of Division.
3. Protective film: Install protective packaging, film and covers in shop before shipping.
4. Provide manufacturer's standard warranty applicable to applicable finish.

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. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

1.4 COLORS FOR RESIN AND POWDER COATINGS

A. Provide colors indicated or specified. Colors, if indicated, may be from one of the following, as indicated or required:
1. Stock color from available full range.
2. Custom color to match office sample provided by Architect.
3. Custom color selected and determined by Architect during submittal process.

4. Selected from AAMA 2605 [Kynar resins] and AAMA 2604 [powder coatings] systems, such as PPG Duranar or Envirocron line, of standard colors, exotic colors, metallic colors and pearlescent colors.
5. Selected from RAL Color space system [a German system developed by *Reichs-Ausschuß für Lieferbedingunge*], and using either “RAL Design” or “RAL Effect”. Sheens as selected.

PART 2 - PRODUCTS

2.1 SHOP/FACTORY FINISHES - GENERAL

A. Concealed steel items provided in connection with other assemblies
1. Refer to section 05 08 50 – Hot Dip Galvanizing
2. Type A: Hot dipped Galvanized - per ASTM A 123 with 2.0 ounces per square foot.

B. Specified aluminum components shall be free of scratches or other serious blemishes and receive a caustic etch followed by an anodic oxide treatment.

C. Anodized Finish: Exposed surfaces with the indicated Architectural Class coating, fully sealed and free of powdery surfaces. Coating shall conform to minimum requirements for thickness and weight of ASTM B 137.

D. Extent: As shown, if not, all panels, trim, copings, members, flashings and closures color coated on exposed faces.

E. Field touch up paint: Provide from manufacturer to exactly match coating as found in field.

2.2 SHOP FINISHES – TYPES

A. Provide finishes indicated, if not indicated, as follows:
1. Exposed aluminum: Type 1.
2. Concealed aluminum in contact with masonry or concrete: As specified in the respective sections.
3. Concealed aluminum: mill finish.
4. Aluminum indicated on drawings as "clear finish": Type 1.

B. Type 1: Anodized Aluminum
1. Class I anodic finish type A41/A42/44.
2. Performance Standard: AAMA 611.
3. Minimum coating thickness: 0.7 mils
4. Min weight: 27.0 mg/in2.
5. Apparent Density: 38.0 g/in3
6. Color: As selected, if not, clear.

C. Type 2: Anodized Aluminum
1. Class II anodic finish type A31/A42/44.
2. Performance Standard: AAMA 611.
3. Minimum coating thickness: 0.4 mils
4. Min weight: 15.0 mg/in2.
5. Apparent Density: 38.0 g/in3
6. Color: As selected, if not, clear.

D. Type 3 – Standard Performance Paint – Acrylic or polyester based .
1. Standard System: High solids polyester equal to "PPG Duracon” two-coat thermo-cured.
2. Performance Standard: Comply with AAMA 2603.
3. Guarantee: 20-year regarding color fading, cracking, chipping and peeling.
4. Preparation: Cleaning and rinsing, conversion treatment followed by rinse and drying.
5. Color /coating system equal to the following PPG are included:
    a. Standard colors: Yes.
    b. Colors indicated on drawings: Yes.
    c. Pearlescent colors: Yes.
    d. Exotic Coatings: Yes.
    e. Metallic coatings: Yes.
    f. Textured: Yes.

E. Type 4 – High Performance Paint – Polyvinylidene fluoride / PVDF.

1. Standard System: "Kynar 500 or Hylar 5000 two-coat thermo-cured.
2. Exotics/Metallics System: If indicated below " Kynar 500XL three-coat thermo-cured.
3. Performance Standard: Comply with AAMA 2605 [620/621 for coil coatings].
4. Guarantee: 20-year regarding color fading, cracking, chipping and peeling.
5. Preparation: Cleaning and rinsing, conversion treatment followed by rinse and drying.
6. Color /coating system equal to the following PPG are included:
    a. Standard colors: Yes.
    b. Duranar “XL” colors: Yes.
    c. Duranar Exotic Coatings: Yes.
    d. Duranar Pearlescent Coatings: Yes.
    e. Duranar ULTRA-Cool Coatings: Yes.
    f. Duranar “XL” plus exotics: No.
    g. Duranar “XL” specialties: No.
    h. Duranar “XLB” specialties: No.
    i. Duranar “XLTS” textured: No.
    j. Endurastone Spatter Coating: No.
7. Color selections will include the following:
    a. Stock colors from full available range of systems above: Yes.
    b. Custom colors to match Architect office samples. Yes.

F. Type 5 – High Performance Powder Coating – Polyester based.
1. Standard System: Equal to PPG "Envirocron Ultradurable Powder Coating” or “Duncan Thermoset”.
2. Performance Standard: Comply with AAMA 2604.
3. Guarantee: **20**-year regarding color fading, cracking, chipping and peeling.
4. Preparation: Cleaning and rinsing, conversion treatment followed by rinse and drying.
5. Dryfilm thickness: 2.0 mil minimum.
6. Color selections will include the following:
    a. Stock colors from full available range of systems above: Yes.
    b. Custom colors to match Architect office samples. Yes.

2.3 PRODUCT PERFORMANCE

A. Weatherometer: When subjected to accelerated weathering test according to ASTM D-822/G-23 for 2500 hours, the maximum chalk shall be No. 9 and color change shall not exceed 3 NBS Units Delta E. When tested for 500 hours in the dew cycle weatherometer (ASTM D-3361) Model XWR, 60/60 cycle, the sample shall not exceed 5 NBS Units Delta E. When subjected to an accelerated weathering test in accordance with ASTM D-822, Apparatus D for 2000 hours, there shall be no more than slightly perceptible color change or chalking. There shall be no checking nor adhesion loss.

B. Abrasion Resistance: (1) Flat specimens, 4" x 8" shall be subjected to falling sand abrasion tests conducted in accordance with Federal Test Method Standard No. 141A, Method 6191 (ASTM D-968), with no less penetration through the finish coating to the primer of 67 liters (89 liters per mil) and penetration through to exposure of base steel 490 liters (258 liters per mil).

C. Bend Test: Sample shall be capable of being bent around a 1/8" diameter mandrel in accordance with ASTM D-1737. Slight micro-checking may occur, but adherence between coatings and to base metal shall be maintained.

D. Impact Test: Coating shall show no loss of adhesion or show no cracking when subjected to 160" per pound as recorded by a Gardner Impact Tester according to ASTM D-2794. Test shall employ a 9/16" ball and there shall be no loss of adhesion when tested with a cellophane tape.

E. Hardness: Shall be "F" minimum pencil hardness (ASTM D-3363).

F. Water Immersion: A specimen shall remain submerged in distilled water at a constant temperature of 100EF in accordance with ASTM D-870 for 300 hours with no evidence of blistering nor loss of adhesion.

G. Salt Spray Test: When subjected to a salt spray (fog) test performed in accordance with ASTM Standard Method B-117-73 for 3000 hours, blistering shall not exceed 5% No. 6 blisters in the field (ASTM D-1654). No more than 1/8" creep corrosion and tape off from area scribed to base metal.

H. Humidity Test: When subjected to a 100% humidity test in accordance with ASTM Standard Method D-2247 for 3000 hours (Cabinet Type A-1) or 250 hours (Cabinet Type A-2), the coating shall show no softening or color change and there shall be a minimum of 95% of the area with no blisters. No blisters shall be larger than ASTM No. 8 when evaluated in accordance with ASTM D-714.

PART 3 - EXECUTION

3.1 APPLICATION / PROTECTION

A. Apply coating to applicable performance standards, manufacturer recommendations , limitations and instructions to properly prepared surfaces. Provide coats and toppings to match indicated coating system in uniform, consistent manner free of defects.

B. At factory option and subject to providing acceptable finish, provide temporary films and other forms of protection required to protect coatings. Instruct installers as to limitations, protection and removal procedures.

3.2 COMPLETION & TOUCH UP

A. Comply with requirements of Division 1.

B. Instruction: Instruct field installers in proper field methods for touch up.

C. Touch up: Installers shall touch up in place work to eliminate any apparent evidence of damage or repair.

END OF SECTION

SECTION 05 08 50 – HOT DIP GALVANIZING

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, requirements for and providing:
1. Hot dip galvanizing.

C. Extent of work without limitation, includes:
1. Ferrous metals indicated to be galvanized.
2. Ferrous metals in exterior assemblies whether exposed to weather or not.
3. Exterior ferrous metals.

D. Related Requirements:
1. Section 05 08 60 Shop Coatings On Galvanizing
2. Section 05 50 00 Miscellaneous Metal Fabrications

1.2 QUALITY ASSURANCE

A. Reference Standards include the latest editions of:
ASTM A123 – Standard Specification for zinc [hot dipped galvanizing] coatings on Iron & Steel
ASTM A153 - Standard Specification for zinc [hot dipped galvanizing] coatings on ferrous hardware
ASTM A143 – Recommended practice for safeguarding against embrittlement and detecting same.
ASTM A384 – Practice for safeguarding against warping and distortion during hot dip galvanizing
ASTM A385 – Standard practice for providing high quality zinc coatings, hot dipped.
NAAMM Metal Finishes Manual
Steel Structure Painting Manual, Volumes 1 and 2
Occupational Safety and Health Standards
State Building Code and Regulations applicable to building systems.

B. Grade Stamps: All galvanized metal shall bear a stamp indicating ASTM number and weight of zinc coating in ounces per square foot.

1.3 SUBMITTALS

A. In accordance with provisions of Division 1 submit the following:

B. Shop Drawings: Indicate specifications for shop finishes and galvanizing on shop drawings.

C. Certification: Furnish a notarized certificate of compliance with specifications and referenced standards.

D. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.4 PRODUCTS DELIVERY AND STORAGE

A. Store galvanized members at the project site above ground on platforms, skids or other supports. Store beams with webs vertical.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials shall conform to the latest edition of the specifications or manufacturer's standards.
1. Zinc: ASTM B6, Prime Western Grade or High Grade
2. Galvanizing ASTM A-123, , or A-153 as applicable; 2.0 ounces zinc per square foot, unless otherwise indicated; provide under its section.
3. Galvanized Sheet Steel ASTM A-526 or A-526, G-90

4. Provide nickel zinc galvanizing bath where shop applied primers or top coats are required containing .05-.09% nickel and other earthly materials.

B. Galvanizing Repair Paint: High zinc dust content paint complying with the following:
1. Designed specifically for field and shop repair of hot dip galvanizing
2. ASTM A 780 Galvanizing repair specification with 65 per cent zinc dust content of dry film or more.
3. SSPC-Paint 20 Type II Organic.
4. DOD-P-21035A for "Paint, High Zinc Dust Content, Galvanizing Repair."
5. Single-component
6. Apply by brush, roller or spray
7. Applicable VOC standards
8. Acceptable product: ZRC Galvilite Galvanizing Repair Compound.

2.2 FABRICATION AND WORKMANSHIP

A. Comply with reference standards and the following:
1. Vents: For all hollow members, size as shown, if not, 0375 inch.
2. Vent locations: Where shown, if not, where approved by Architect.
3. Do not galvanize until all welds have been ground smooth.
4. Minimize surface imperfections (eg: flux inclusions), by dipping material in a solution of Zinc Ammonium Chloride (pre-flux) immediately prior to galvanizing.
5. Flux blanket overlaying molten zinc will not be permitted.
6. ASTM A 153 for galvanizing iron and steel hardware, zinc thickness in accordance with standard.
7. ASTM A 123 for galvanizing rolled, pressed and forged steel shapes, plates, bars and strip 1/8" thick and heavier, grade 85 unless otherwise indicated.
8. ASTM A 386 for galvanizing assembled steel products, with 2 ounces per square foot unless otherwise indicated.
9. After galvanizing, chromate material by dipping material in a 0.2% chromic acid solution.

2.3 SHOP COATINGS AFTER GALVANIZING

A. Where indicated, Section 05 08 60.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with requirements of section 01 70 00 – Execution, and the following:
1. Inspect field conditions and correct imperfections affecting work.
2. Touch-Up of Shop Primers: Touch up field welds and unprimed steel using specified shop primers and following procedures specified for shop work.
3. Galvanizing: Repair all zinc-coating that has been damaged in handling or transporting or in welding, riveting, or bolting by wire brushing to bright metal and applying two (2) coats of a galvanizing repair paint conforming to specifications.

END OF SECTION

SECTION 05 08 60 – SHOP COATINGS ON GALVANIZING

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Thermoset primers.
2. Thermoset topcoats.
3. Solvent primers.
4. Solvent top coats.

C. Extent of work without limitation, includes:
1. Indicated coatings applied on hot dipped galvanized metal visible from or exposed to exterior.
2. Wherever such coatings are indicated on drawings.

D. Related Requirements:
1. Section 05 08 50 Hot Dip Galvanizing
2. Section 05 50 00 Miscellaneous Metal Fabrications
3. Section 05 52 10 – Steel Railings

1.2 QUALITY ASSURANCE

A. Comply with the following:
1. Galvanizing method and facility: - acceptable to coating fabricator/manufacturer.
2. Coordinate work, shop drawings and processes.
3. Fabricator: 10 years experience or more in coating processes.

1.3 SUBMITTALS

A. In accordance with provisions of Division 1 submit the following:
1. Product Data: For all product types specified in this section.
2. Shop Drawings: Indicate specifications for shop finishes on shop drawings.
3. Certification: Furnish a notarized certificate of compliance with specifications and referenced standards.

B. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.4 PRODUCTS DELIVERY AND STORAGE

A. Store coated members at the project site above ground on platforms, skids or other supports. Store beams with webs vertical.

1.5 WARRANTY

A. Warranty: Provide a 20 year warranty against rust and 15 year warranty against coating failure.

PART 2 - PRODUCTS

2.1 PRIME COATINGS AFTER GALVANIZING

A. Coating products & Materials / Type 1 - Baked-on, solvent based:
1. Duncan Galvanizing of Everett, MA "PrimerGalv"
2. Valmont Coatings / Applied Coating Technology, Mendota Heights, MN 55120
3. Approved equal.

B. Factory-Applied Universal Primer: Provide factory-applied polyamide epoxy or urethane primer, 2.0 mils dry film thickness minimum. Apply primer within twelve (12) hours after galvanizing at the galvanizer's plant in a controlled environment meeting applicable environmental regulations, and as recommended by coating manufacturer utilizing a cure facility capable of reaching 130 degrees F.
   1. In the event coatings are not applied within 12 hours of exposure to oxygen, work shall be re-galvanized or Zinc Hydroxide formations shall be completely removed.
   2. Color shall be appropriate for finish color selected by Architect. Two contrasting color application where noted.

C. On members to be left exposed to view, remove burrs as necessary during fabrication and galvanizing process to provide smooth defect free surfaces.

D. Schedule of shop finishing:
   1. Galvanized work exposed to view [whether partially or wholly].
   2. Fabricated assemblies exposed to view including tube and pipe assemblies.

2.2 TOP COATINGS AFTER PRIMING

A. Finish coat: Comply with following:
   1. Basis of design: Duncan Galvanizing, "ColorGalv" or if approved ", ColorThermoset 15."
   2. Type: Factory-applied color-pigmented architectural finish.
   3. Finish coat application: Applied at galvanizer's plant.
   4. Schedule of shop top coats: All fabricated assemblies exposed to view including tube and pipe assemblies.
   5. Color:
      a. Finish color: As selected by Architect.
      b. Number of colors: 2 contrasting color applications unless more are indicated.
      c. Standard colors: Yes.
      d. Custom color: Not unless noted or scheduled.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with requirements of Division 1, and the following:
   1. Inspect field conditions and correct imperfections affecting work.
   2. Galvanizing: Repair zinc-coating damaged by handling or transporting, welding, riveting, or bolting with wire brushing to bright metal and apply two (2) coats of galvanizing repair paint conforming to specifications.
   3. Touch-Up of Shop Primers and if applicable, topcoats: Touch up field welds and damaged steel finish surfaces using specified shop primers and topcoats. Follow procedures specified for shop work.

END OF SECTION

SECTION 05 12 00 - STRUCTURAL STEEL FRAMING

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. Structural steel.
2. Grout.

B. Related Sections:

1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
2. Division 01 Section “Construction Waste Management”
3. Division 05 Section "Steel Decking" for field installation of shear connectors through deck.
4. Division 05 Section "Metal Fabrications" for miscellaneous steel fabrications not defined as structural steel.

1.3 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.4 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using industry standards.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.

4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
5. Identify members and connections of the seismic-load-resisting system.
6. Indicate locations and dimensions of protected zones.
7. Identify demand critical welds.
8. For structural-steel connections indicated to comply with design loads, include structural design data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Qualification Data: For qualified installer and fabricator.

D. Welding certificates.

E. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

F. Mill test reports for structural steel, including chemical and physical properties.

G. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength bolt-nut-washer assemblies.
4. Shear stud connectors.
5. Shop primers.
6. Nonshrink grout.

H. Source 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 STD.

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

D. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. AISC 341 and AISC 341s1.
3. AISC 360.
4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.8 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992/A 992M or ASTM A 572/A 572M, Grade 50

B. Channels, Angles: ASTM A36

C. Plate and Bar: ASTM A36.

D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B structural tubing.

E. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.

1. Weight Class: As Indicated.
2. Finish: black unless otherwise indicated.

F. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts;

B. High-Strength Bolts, Nuts, and Washers: ASTM A 490 (ASTM A 490M), Type 1, heavy-hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends.

1. Direct-Tension Indicators: ASTM F 959, Type 490 (ASTM F 959M, Type 10.9), compressible-washer type with plain finish.

C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy hex head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: plain.

D. Unheaded Anchor Rods: ASTM F 1554, Grade 36 unless noted otherwise.

1. Configuration: As indicated.
2. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
3. Plate Washers: ASTM A 36/A 36M carbon steel.
4. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
5. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.

E. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.

1. Nuts: ASTM A 563 (ASTM A 563M) heavy-hex carbon steel.
2. Plate Washers: ASTM A 36/A 36M carbon steel.
3. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
4. Finish: Plain.

F. Threaded Rods: ASTM A 36/A 36M.

1. Nuts: ASTM A 563 (ASTM A 563M) [heavy-]hex carbon steel.
2. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened.
3. Finish: As indicated.

G. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.

H. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.

2.3 PRIMER

A. Primer: Comply with Division 09 painting Sections.

B. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

C. Galvanizing Repair Paint: SSPC-Paint 20.

2.4 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural steel. Straighten as required to provide uniform, square, and true members in completed wall framing.

F. Welded Door Frames: Build up welded door frames attached to structural steel. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches (250 mm) o.c. unless otherwise indicated.

G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug Tightened except at braced bays. Provide slip critical fasteners at bolted braced bay connections.

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. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7 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 (50 mm).
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.

4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.

B. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.8 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.

1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize lintels and beams attached to structural-steel frame and located in exterior walls.

2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

PART 3 - EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT

A. The contractor, subcontractors, and their personnel shall follow the procedures and practices for waste separation, collection and transport as defined in the contractor’s “Waste Management Plan” as required by Division 01 Section "Construction Waste Management."

3.2 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.4 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Base bearing 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 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.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. 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 is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection unless approved by the Structural Engineer of Record.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.5 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: As indicated on approved shop drawings.

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 AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Bolted Connections: Bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.

1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

a. Liquid Penetrant Inspection: ASTM E 165.
b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
c. Ultrasonic Inspection: ASTM E 164.
d. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.7 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

C. Touchup Painting: Cleaning and touchup painting are specified in Division 09 painting Sections.

END OF SECTION 05 12 00

SECTION 05 31 00 - STEEL DECKING

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. This Section includes the following:

1. Roof deck.

B. Related Sections include the following:

1. Division 03 Section "Cast-in-Place Concrete" for concrete fill.
2. Division 05 Section "Structural Steel Framing" for shop- and field-welded shear connectors.
3. Division 05 Section "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
4. Division 01 Section “Construction Waste Management”

1.3 SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

C. Product Certificates: For each type of steel deck, signed by product manufacturer.

D. Welding certificates.

E. Field quality-control test and inspection reports.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

1. Power-actuated mechanical fasteners.

G. Research/Evaluation Reports: For steel deck.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.

B. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

C. Fire-Test-Response Characteristics: Where indicated, provide steel deck units identical to those tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by design designations of applicable testing and inspecting agency.
2. Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency.

D. 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."

E. FMG Listing: Provide steel roof deck evaluated by FMG and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Steel Deck:

a. ASC Profiles, Inc.
b. Canam Steel Corp.;The Canam Manac Group.
c. Consolidated Systems, Inc.
d. DACS, Inc.
e. D-Mac Industries Inc.
f. Epic Metals Corporation.
g. Marlyn Steel Decks, Inc.
h. New Millennium Building Systems, LLC.
i. Nucor Corp.; Vulcraft Division.
j. Roof Deck, Inc.
k. United Steel Deck, Inc.
l. Valley Joist; Division of EBSCO Industries, Inc.
m. Verco Manufacturing Co.
n. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

2.2 ROOF DECK

A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:

1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 (230) G60 zinc coating.
2. Deck Profile: Type WR, wide rib.
3. Profile Depth: 1-1/2".
4. Design Uncoated-Steel Thickness: As Indicated.
5. Span Condition: Three Span or more where possible.
6. Side Laps: Overlapped.

2.3 ACCESSORIES

A. General: 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 (4.8-mm) minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

G. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.

H. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck, with 3-inch- (76-mm-) wide flanges and sloped recessed pans of 1-1/2-inch (38-mm) minimum depth. For drains, cut holes in the field.

I. Flat Sump Plate: Single-piece steel sheet, 0.0747 inch (1.90 mm) thick, of same material and finish as deck. For drains, cut holes in the field.

J. Galvanizing Repair Paint: ASTM A 780, SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

K. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT

A. The contractor, subcontractors, and their personnel shall follow the procedures and practices for waste separation, collection and transport as defined in the contractor's "Waste Management Plan" as required by Division 01 Section "Construction Waste Management."

3.2 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.3 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.4 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches (38 mm) long, and as follows:

1. Weld Diameter: 5/8 inch nominal.
2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds 12 inches (305 mm) apart in the field of roof and 6 inches (150 mm) apart in roof corners and perimeter, based on roof-area definitions in FMG Loss Prevention Data Sheet 1-28.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 36 inches, and as follows:

1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm), with end joints as follows:

1. End Joints: Lapped 2 inches (51 mm) minimum.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space fasteners not more than 12 inches (305 mm) apart with at least one fastener at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. 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.

F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 31 00

SECTION 05 40 00 - COLD-FORMED METAL FRAMING

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. Types of cold-formed metal framing units include the following:

1. Roof trusses.
2. Ceiling joist framing.

B. Related Sections include the following:

1. Division 01 Section “Construction Waste Management”

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As noted on the drawings.

2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:

a. Roof Trusses: Vertical deflection of 1/360 of the span.

b. Ceiling Joist Framing: Vertical deflection of 1/360 of the span.

3. Design framing systems to provide for movement of framing members 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 (67 deg C).

4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:

   a. Upward and downward movement of ¾".

B. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."

1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."

2. Roof Trusses: Design according to AISI's "Standard for Cold-Formed Steel Framing - Truss Design."

1.4 SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

B. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 QUALITY ASSURANCE

A. Component Design: Calculate structural properties of studs and joists in accordance with American Iron and Steel Institute (AISI) "Specification for Design of Cold-Formed Steel Structural Members."

B. Welding: Use qualified welders and comply with American Welding Society (AWS) D1.3, "Structural Welding Code - Sheet Steel."

C. Fire-Rated Assemblies: Where framing units are components of assemblies indicated for a fire-resistance rating, including those required for compliance with governing regulations, provide units that have been approved by governing authorities that have jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:

1. Alabama Metal Industries Corp.

2. Dale Industries, Inc.

3. Dietrich Industries, Inc.

4. Marino Industries, Inc.

5. USG Industries

6. United States Steel

7. Wheeling Corrugating Co.

2.2 METAL FRAMING

A. System Components: Manufacturers' standard load-bearing steel studs and joists of type, size, shape, and gage as indicated. With each type of metal framing required, provide manufacturer's standard, steel runners (tracks), blocking, lintels, clip angles, shoes, reinforcements, fasteners, and accessories for applications indicated, as needed to provide a complete metal framing system.

B. Materials and Finishes:

1. For 16-gage and heavier units, fabricate metal framing components of structural quality steel sheet with a minimum yield point of 40,000 psi; ASTM A 446, A 570, or A 611.

2. For 18-gage and lighter units, fabricate metal framing components of commercial quality steel sheet with a minimum yield point of 33,000 psi; ASTM A 446, A 570, or A 611.

3. Provide galvanized finish to metal framing components complying with ASTM A 525 for minimum G 60 coating.

4. Fasteners: Provide nuts, bolts, washers, screws, and other fasteners with corrosion-resistant plated finish.

5. Electrodes for Welding: Comply with AWS Code and as recommended by stud manufacturer.

6. Galvanizing Repair: Where galvanized surfaces are damaged, prepare surfaces and repair in accordance with procedures specified in ASTM A 780.

2.3 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C or mechanically deposition according to ASTM B 695, Class 50.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.

1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.4 FABRICATION

A. General: Framing components may be prefabricated into assemblies before erection. Fabricate panels plumb, square, true to line, and braced against racking with joints welded. Perform lifting of prefabricated units to prevent damage or distortion.

B. Fastenings: Attach similar components by welding. Attach dissimilar components by welding, bolting, or screw fasteners, as standard with manufacturer.

C. Wire tying of framing components is not permitted.

D. Fabrication Tolerances: Fabricate units to a maximum allowable tolerance variation from plumb, level, and true to line of 1/8 inch in 10 feet.

PART 3 - EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT

A. The contractor, subcontractors, and their personnel shall follow the procedures and practices for waste separation, collection and transport as defined in the contractor's "Waste Management Plan" as required by Division 01 Section "Construction Waste Management."

3.2 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 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 are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

C. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.

3.4 INSTALLATION

A. General: Install metal framing systems in accordance with manufacturer's printed or written instructions and recommendations.

B. Runner Tracks: Install continuous tracks sized to match studs. Align tracks accurately to layout at base and tops of studs. Secure tracks as recommended by stud manufacturer for type of construction involved, except do not exceed 24 inches o.c. spacing for nail or power-driven fasteners or 16 inches o.c. for other types of attachment. Provide fasteners at corners and ends of tracks.

C. Installation of Wall Studs: Secure studs to top and bottom runner tracks by either welding or screw fastening at both inside and outside flanges.

D. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

E. Where stud system abuts structural columns or walls, including masonry walls, anchor ends of stiffeners to supporting structure.

F. Install supplementary framing, blocking, and bracing in metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar Work requiring attachment to the wall or partition. Where type of supplementary support is not otherwise indicated, comply with stud manufacturer's recommendations and industry standards in each case, considering weight or loading resulting from item supported.

G. Frame wall openings larger than 2 feet square with double stud at each jamb of frame except where more than two are either shown or indicated in manufacturer's instructions. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with stud shoes or by welding, and space jack studs same as full-height studs of wall. Secure stud system wall opening frame in manner indicated.

H. Frame both sides of expansion and control joints with separate studs; do not bridge the joint with components of stud system.

I. Install horizontal stiffeners in stud system, spaced (vertical distance) at not more than 54 inches o.c. Weld at each intersection.

J. Erection Tolerances: Bolt or weld wall panels (at both horizontal and vertical junctures) to produce flush, even, true-to-line joints.

1. Maximum variation in plane and true position between prefabricated assemblies should not exceed 1/16 inch.

K. Installation of Joists: Install level, straight, and plumb, complete with bracing and reinforcing as indicated on drawings. Provide not less than 1-1/2-inch end bearing.

L. Reinforce ends with end clips, steel hangers, steel angle clips, steel stud section, or as otherwise recommended by joist manufacturer.

M. Where required, reinforce joists at interior supports with single short length of joist section located directly over interior support, snap-on shoe, 30 percent side-piece lapped reinforcement, or other method recommended by joist manufacturer.

N. Secure joists to interior support systems to prevent lateral movement of bottom flange.

O. Field Painting: Touch-up damaged shop-applied protective coatings. Use compatible primer for prime-coated surfaces; use galvanizing repair system for galvanized surfaces.

P. Joist reinforcement at interior support shall be short length of joist section located directly over the interior support and fastened to the joists with four screws. Steel joist and reinforcement shall be installed so that there is full bearing on the support. Minimum bearing at interior support shall be 3 □" unless otherwise specifically designed.

Q. Each joist shall be attached to or restrained at the interior support by fasteners to prevent lateral movement of the bottom flange.

R. Significant temporary concentrated floor or roof loads, such as construction loads due to stacking of heavy building materials, shall be avoided during construction unless adequate additional means for carrying their loads have been provided.

S. All supports of steel joists (beams) should be in place prior to steel joist installation.

3.5 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

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 Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 40 00

SECTION 05 43 00 – SLOTTED CHANNEL STRUT FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section Includes, without limitation, providing:
1. Steel slotted channel strut framing.
2. Associated fittings and hardware.
3. Use of bolted metal framing.

C. Extent, without limitation, includes: Indicated assemblies.

D. Definitions: Slotted channel framing is customarily know as the trademarked product, “UniStrut®”.

E. Related Sections, without limitation, include:
1. Section 05 50 00 – Miscellaneous metal fabrications.

1.2 SUBMITTALS

A. Comply with Division 01 General Requirements and submit for approval:
1. Product Data: Manufacturer’s literature including installation instructions, use restrictions and limitations, and the following:
   a. Types, materials, finishes, gauge thickness, and hole patterns.
   b. For each different strut cross-section, cross sectional properties including Section Modulus (S_X) and Moment of Inertia (I_X).
2. Structural calculations: Without limitation, include:
   a. Description of design criteria.
   b. Stress and deflection analysis.
   c. Selection of framing members, fittings, and accessories
3. Shop drawings: Large scale drawings for strut and accessories including clamps, brackets, hanger rods, and fittings. Provide templates for work installed by others.
   a. Field Measurements: Take accurate field measurements before fabrication and indicate same on shop drawings.
4. Certification: Certify submitted materials comply with requirements.

B. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Comply with Division 01 requirements and governing codes and regulations.

B. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

C. Manufacturers: Firms regularly engaged in the manufacture of bolted metal framing of the types required, whose products have been in satisfactory use in similar service for not less than 5 years.

D. Installer qualification, for Unistrut: Unistrut trained manufacturer’s authorized representative/installer with not less than 5 years experience in the installation of Strut Systems of this size and conformation.

E. MFMA Compliance: Comply with the latest revision of MFMA Standards Publication Number MFMA-3, "Metal Framing Standards Publication".

F. NEC Compliance: Comply with the latest revision NFPA 70 - Article 352 "Surface Metal Raceways and Surface Nonmetallic Raceways".

G. UL Compliance: Comply with UL "Standard for Surface Metal Raceway and Fittings", UL 5.

H. Bolted framing channels and fittings shall have the manufacturers name, part number, and material heat code identification number stamped in the part itself for identification. Material certification sheets and test reports must be made available by the manufacturer upon request.

I. Stainless steel bolted framing parts shall be stamped to identify the material. Material certification sheets and test reports must be made available by the manufacturer upon request.

PART 2 - PRODUCTS

2.1 STEEL SYSTEM MANUFACTURER

A. Steel system - acceptable manufacturers and fabricators include:
1. Unistrut Corporation, Itasca IL; www.unistrut.com/.
2. Cooper Industries; www.cooperindustries.com/. [aka B-line by Eaton].
3. Haydon Corp., H-strut Division; www.2haydon.com/.
4. Johnson Brothers Metal Forming; www.johnsonrollforming.com/.

B. Basis of design: System shown on drawings, if not, as recommended by manufacturer and installer for application, with factor of safety approved by Architect.

2.2 ALUMINUM SYSTEM MANUFACTURER

A. Refer to section 05 45 10.

2.3 STEEL STRUT CHANNELS & COMPONENTS

A. Strut size and capacity: As shown, if not, as recommended by the manufacturer for the application from one of the following:
1. Configuration: Vary heights and welded combinations as required to meet load capacities and designs indicated.
2. 1.625 inch [41mm] series channels; use 12 or 14 or 16 gage as required for application.
3. 1.25 inch [32mm] series channels; 14 gage or 19 gage as required by applications.
4. 0.815 inch (13/16) [21mm] series channels. Use only 19 gage or heavier; Unistrut P-6000 or P-7000 [16 foot and 10 foot types respectively.

B. Required types: Provide channel types as required by application including:
1. Curved.
2. Solid.
3. Pierced.
4. Slotted.
5. Combination and stacked.
6. Hole pattern: As required for application; include KO, knock-out types if needed.
7. Telescoping sections: Provide “telestrut” tubing as required.

C. Accessories: Provide required components to complete and install work including:
1. Nuts, bolts and hardware, including spring nuts and grip edge nuts.
2. Plates, angle fittings, clip angles, wing fittings.
3. Bases, brackets and clamps.
4. Special application trolleys.
5. Pipe/conduit clamps and supports.
6. Hangers.
7. Electrical accessories.
8. Inserts for concrete.

D. Materials and Finish: As shown, if not, as follows:
1. Epoxy Painted:
a. Material: Steel meeting minimum properties of ASTM A1011 SS Grade 33,
b. Coating: Water born epoxy applied by cathodic electro-deposition process.

c. Fittings: Steel meeting minimum requirements of ASTM A907 SS, Grade 33.
d. Fittings and hardware: Zinc plated per ASTM B633 (SC3 for fittings, SC1 for threaded hardware).

2. Stainless Steel: Struts, fittings and hardware: AISI Type 316 stainless steel.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the provisions of Section 01 70 00.

B. Install materials and systems in accordance with manufacturer's instructions, limitations and restrictions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.

C. If required by manufacturer, install system by factory trained and authorized mechanics and installers.

D. Ensure all assemblies have open ends to ensure proper venting and drying.

3.2 INSTALLATION STEEL STRUTS

A. Install strut in accordance with MFMA-102 “Guidelines for the Use of Metal Framing” and recognized industry practices.

B. Install assemblies plumb, plane and true. Slope assemblies if indicated or required for drainage of supported piping.

C. Cuts: Finish cuts with zinc rich, “liquid galvanizing” such as ZRC or with matching epoxy paint.

D. Tighten nuts and bolts not less then the following bolt size / torque in foot pounds:
1. 1/4 - 20 / 6
2. 5/16 - 18 / 11
3. 3/8 - 16 / 19
4. 1/2 - 13 / 50

END OF SECTION

SECTION 05 50 00 – MISCELLANEOUS METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: All Contract Documents, including Drawings, and Division 1 General Requirements apply to this Section.

B. Section includes, without limitation, providing:
1. Shop applied ferrous metals priming paint
2. Anchorages, brackets, supports, inserts and backing required for a complete job but not included in other sections.
3. All other ferrous or non-ferrous metal work not specifically given to other Sections and necessary for a complete job.

C. Related work includes, without limitation:
Section 05 08 00 - Factory applied metal coatings
Section 05 08 50 - Hot dip galvanizing
Section 05 08 60 - Shop coatings on galvanizing
Section 05 12 00 – Structural Steel:
Section 09 90 10 – Painting.

1.2 QUALITY ASSURANCE

A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication where adjacent construction is in place. Do not delay job progress: allow for trimming and fitting wherever taking field measurements before fabrication might delay work.

B. Setting Drawings: Provide setting drawings, templates, instructions and directions for installation of anchorage devices supplied under this Section. Coordinate delivery through Construction Manager to avoid delay.

C. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

D. Reference Standards include the latest editions of::
Code of Standard Practice for Steel Buildings and Bridges
Specification for the Design, Fabrication and Erection of Structural Steel Construction
Standard Code for Welding in Building Construction of the American Welding Society.
NAAMM Metal Product Outline for Division 5 - Metals
NAAMM Metal Bar Grating Manual
NAAMM Pipe Railing Manual
NAAMM Metal Stairs Manual
NAAMM Metal Finishes Manual
Steel Structure Painting Manual, Volumes 1 and 2
Occupational Safety and Health Standards
State Building Code and Regulations applicable to building systems.
SSINA Specialty Steel Industry of North America - Published recommendations

E. Qualifications of Personnel: Fabrication and erection shall be done by workmen skilled in this type of work. Welds shall be made only by welding operators who have been previously qualified to perform this work by tests as prescribed in the "Standard Code for Welding in Building Construction" of the American Welding Society.

F. Grade Stamps: All galvanized metal shall bear a stamp indicating ASTM number and weight of zinc coating in ounces per square foot.

G. Testing: All work shall be subject to inspections and tests by an independent testing agency to be paid for in accordance with the general requirements of the contract.

1.3 SUBMITTALS

A. In accordance with provisions of Division 1 submit the following:

B. Shop Drawings: Submit complete shop drawings for all work. Include plans and elevations at not less than 1/2" to 1'-0" scale, and include details at not less than 3" to 1'-0" scale. Show anchorage and accessory items.

Approval of shop drawings shall be for size, arrangement, and overall suitability of members and details shown and does not relieve the Contractor of his responsibility for the strength of connections, correctness of dimensions, size and quantities, and general fit up of parts.

Indicate specifications for shop finishes and galvanizing on shop drawings.

C. Engineering Calculations: Calculations stamped by a registered professional engineer are required for window cleaner's trolley support structures, and other load bearing fabrications. The Structural Engineer's written approval of such calculations shall be obtained before commencing fabrication

D. Samples: Submit 8" square samples of each metal shop or factory finish (final surface treatment) required. Prepare samples on metal of same alloy and gauge to be used for the work. Label each sample to identify substrate material and finish. Provide hardware samples.

E. Certification:
1. Notarized Affidavit from an officer of the steel fabricator will be required stating that all steel (except circular pipes) including connections, plates, etc., furnished for this job does comply with ASTM Specification A36, and with these specifications.
2. Galvanizer shall furnish a notarized certificate of compliance with specifications.
3. Guardrail manufacturer shall furnish certification that all material furnished was tested and complies with specifications.

F. Manufacturer's Data: Submit manufacturer's specifications, anchor details and installation instructions for any prefabricated products to be used in the work of this section

G. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.4 PRODUCTS DELIVERY AND STORAGE

A. Store steel members at the project site above ground on platforms, skids or other supports. Store beams with webs vertical.

B. Protect steel from weather and corrosion.

C. Store other materials in a weather-tight and dry place, until ready for use in the work.

D. Store packaged materials in their original unbroken package or container.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials shall conform to the latest edition of the specifications or manufacturer's standards.
1. Steel Shapes ASTM A-36 Bars & Plates
2. Anchor Bolts ASTM A-307 Grade A
3. Structural Bolts ASTM A-325 (unless shown or indicated otherwise)
4. Weld Material E70XX Welding Electrodes For manual shielded metal-arc welding, AWS A5.1 or A5.5, E60 or E70 series
5. Galvanizing ASTM A-123, , or A-153 as applicable; 2.0 ounces zinc per square foot, unless otherwise indicated; provide under its section.
6. Stainless Steel Type 304L, ASTM A 276
7. Steel bar gratings ASTM A-569 or A-36
8. Guardrail AASHO M-180
9. Bitumastic Preservative Mil-P-15230 [Where shown and all embedded steel]

10. Galvanized Sheet Steel ASTM A-653 G-90 or G-115 at wet areas or below grade areas.
11. Hot-Rolled Carbon Steel Bars (and Bar-Size Shapes): ASTM A-36 or A-529, grade as selected by fabricator.
12. Steel Pipe Railings: ASTM A-53; type as selected; Grade A, black finish unless galvanizing is required; standard weight (Schedule 40), unless otherwise shown or specified. 1 1/4" i.d. unless shown otherwise on the Drawings, welded construction with welds ground smooth. Galvanizing as specified in this Section.
13. High Strength Tube Steel: ASTM A1085, cold formed welded, with minimum yield strength of 50 ksi and minimum tensile strength of 65 ksi. Work on the exterior, in exterior assemblies or installed in humid, damp or wet environments shall be hot dipped galvanized.
14. Non-shrink grout: CGM "Por-Rok" or equal.
15. Brackets, flanges and exposed fastenings: Shall be of the same materials, color and finish as the metal to which they are applied, unless shown or specified otherwise.
16. Expansion bolts at concrete: "Redhead" wedge anchors.
17. Expansion bolts at CMU: Hilti epoxy/masonry anchors

B. Hangers and suspension: Where required, provide “Uni-strut” A1000 or assemblies of types recommended by manufacturer for application; see www.unistrut.us/

C. Metal Surfaces, General: For fabrication of miscellaneous metal work which will be exposed to view, use materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness.

D. Metal Gauges: Gauges of sheet iron and steel as indicated are U.S. Standards for sheet and plates. Gauges of non-ferrous metals are per Browne and Sharpe designations.

E. Galvanizing Repair Paint: High zinc dust content paint, “ZRC”, having 95% zinc. by weight.

2.2 FABRICATION AND WORKMANSHIP

A. Use materials of size and thickness shown or, if not shown, of required size and thickness to produce strength and durability in finished product. Work to dimensions shown or accepted on shop drawings using proven details of fabrication and support. Use type of materials shown or specified for various components of work.

B. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32" unless otherwise shown. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

C. Weld corners, joints, and seams continuously, complying with AWS and SSINA recommendations. Grind exposed welds smooth and flush, to match and blend with adjoining surfaces. Shop grind all work unless specifically approved otherwise. Exposed welds shall be indistinguishable in appearance from adjacent metal surfaces.

D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type shown or, if not shown, use Phillips flat-head screws or bolts countersunk flush with adjacent surfaces.

E. Provide for anchorage of type shown, coordinated with supporting structure. Fabricate and space anchoring devices as shown and as required to provide adequate support for intended use.

F. Cut, reinforce, drill and tap miscellaneous metal work as required to receive finish hardware and similar items. Punch and drill steel as indicated for connections and for attachment of other materials. When not indicated, punch and drill steel only upon approval of the Architect.

G. Provide special welding techniques required to perform the work. In particular, prevent distortion or degradation to welded stainless steel and other specialty metals of means recommended by SSINA including the use of heat sinks, skip welding, and clamping. Unless otherwise noted exposed welds shall fully comply with welding requirements specified above.

2.3 SHOP PAINTING

A. Shop prime miscellaneous metals except galvanized metal and portions of members to be field welded. Comply with the following:

B. Remove scale, rust and other deleterious materials before applying shop coat. Clean off heavy rust and loose mill scale in accordance with SSPC SP-3 "Power Tool Cleaning," or SSPC SP-7 "Brush-Off Blast Cleaning."

C. Remove oil, grease and similar contaminants in accordance with SSPC SP-1 "Solvent Cleaning."

D. Immediately after surface preparation, brush or spray on one coat of specified primer in accordance with manufacturer's instructions, and SSPC-PA1 "Paint Application No. 1". Provide a uniform dry film thickness of 2.0 mils. Use painting methods which will result in full coverage of joints, corners, edges and exposed surfaces.

2.4 GALVANIZING & SHOP PRIMERS FOR GALVANIZED WORK

A. Refer to section 05 08 50 and 05 08 60.

2.5 MISCELLANEOUS FRAMING AND SUPPORTS

A. Provide miscellaneous steel framing and supports which are not a part of structural steel framework, as required.

B. Fabricate miscellaneous units to sizes, shapes and profiles shown or, if not shown, of required dimensions to receive work to be supported by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.

C. Equip units with integrally welded anchor straps for casting into poured concrete or building into masonry wherever required. Furnish concrete inserts if units must be installed after concrete is placed.

2.6 LOOSE LINTELS

A. Refer to Structural drawings.

2.7 MISCELLANEOUS COMPONENTS FRAMING AND SUPPORTS

A. Provide plates, bolts and related metal items necessary to complete the work.

B. Provide miscellaneous steel framing and supports which are not a part of structural steel framework, as required.

C. Fabricate miscellaneous units to sizes, shapes and profiles shown or, if not shown, of required dimensions to receive work to be supported by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.

D. Equip units with integrally welded anchor straps for casting into poured concrete or building into masonry wherever required. Furnish concrete inserts if units must be installed after concrete is placed.

PART 3 - EXECUTION

3.1 INSPECTION

A. Review existing field conditions of areas to receive the work of this Section before proceeding with fabrication. Do not proceed with installation of metal fabrications until all unsatisfactory conditions which would impair the strength or appearance of the work have been corrected.

3.2 INSTALLATION OF METAL FABRICATIONS

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners and furnish all necessary setting drawings, diagrams, and templates where necessary for securing miscellaneous metal items to in-place construction including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required. Use galvanized bolts at exterior. Coordinate delivery of such items to project site.

B. Cutting: Perform cutting, drilling and fitting required for installation of miscellaneous metal items. Do not cut structural members in field to facilitate fitting without written permission of the Architect for each specific condition.

C. Fitting: Fit exposed connections accurately together to form tight hairline joints. Weld connections which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind joints smooth. Do not weld, cut or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.

D. Placement: Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry or similar construction.

E. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work. Do not field weld stainless steel or aluminum.

F. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

G. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

H. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.
3. Non-ferrous metals: Same as cast aluminum.

I. Grouting: Set bearing plates required for support of the work of this Section level and to correct elevation using steel shims or wedges and grout solid using specified non-shrink grout.

J. Touch-Up of Shop Primers: Touch up field welds and unprimed steel using specified shop primers and following procedures specified for shop work.

K. Galvanizing: Repair all zinc-coating that has been damaged in handling or transporting or in welding, riveting, or bolting by wire brushing to bright metal and applying two (2) coats of a galvanizing repair paint conforming to specifications MIL-P-21035.

L. Existing work: Remove and re-install or re-locate existing metal fabrications as required to complete the work.. Drill, tap, or weld existing assemblies as required to complete the work and to attach existing work to new work.

3.3 CLEAN UP

A. Keep work areas safe and clean. Sweep up and remove debris resulting from the work of this Section daily.

B. Restore, repair or replace any work of other trades soiled or damaged by the metal fabrications work.

C. At the completion of the job, remove all scrap and debris from the job site.

END OF SECTION

SECTION 05 51 50 - LADDERS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: All Contract Documents, including Drawings, and Division 1 General Requirements apply to this Section.

B. Section includes, without limitation, providing custom fabricated ladders at:
1. Locations shown on drawings.

1.2 SUBMITTALS

A. Comply with Division 1 General Requirements and submit for approval:
1. Product Data: Manufacturer's literature including installation instructions, use restrictions and limitations.
2. Shop drawings: Large scale drawings for fabrication, installation and erections including plans, elevations, details, anchorages, connections and accessories along with head, jamb, sill and joining details. Provide templates for work installed by others.
3. Field Measurements: Take accurate field measurements before fabrication and indicate same on shop drawings.

B. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Manufacturer/Fabricator Qualifications: A firm experienced in producing metal ladders with:
1. Record of successful in-service performance.
2. Sufficient production capacity to produce required units.
3. Professional engineering competent in design and structural analysis to fabricate ladders in compliance with industry standards and local codes.

B. Standards: Comply with ANSI A14.3 and OSHA 29 CFR including 1910.28(b)(9)(i)(B). Provide Ladder Safety or Fall Protection System meeting specified standards.

C. Fixed and Ladder Design Requirements:
1. Safety system: For ladders 24 feet and longer including:
   a. Fall arrest cabling.
   b. Safety harness.
2. Safety system: For ladders in high or hazardous areas.
3. Landing platforms: At 50 feet above bottom of ladder.
4. Minimum of 16 inch width.

1.4 PRODUCTS REQUIREMENTS

A. Comply with product requirements, delivery storage and handling provisions of Division 01.

1.5 WARRANTY

A. Provide written 5-year warranty that installation will be free of defects such as defects beyond normal wear and tear.

PART 2 - PRODUCTS

2.1 STANDARDS & SAFETY

A. Standards: Comply with ANSI A14.3 and OSHA, current standards. Provide Ladder Safety Systems and Fall Protection meeting specified standards.

2.2 CUSTOM GALVANIZED STEEL LADDERS

A. Standards: Comply with Quality Assurance above.

B. Comply with the following ladder construction and fabrication requirements:
1. Width: 20 inches.
2. Rails: 0.375 thick x 3 inch steel bar or steel channel C3x5.
3. Rail height:
   a. Above top rung: 42 inches or maximum permitted by space.
   b. Above elevator pit top rung: 48 inches per ASME A17.1.
4. Rung construction/fabrication:
   a. Material: #7 deformed steel reinforcing bar or McNichols “Grip Strut” 0.68x 1.87 inches.
   b. Spacing: Uniform, maximum 12 inches on center.
   c. Wall clearance: 7 inches. Confirm elevator ladder requirements with elevator installer.
   d. Rung to rail load connection: Welded, 300 pound minimum capacity.
5. Ladder attachment: Steel clip angles at each rail bottom, top, and not over 5 feet on center.
6. Clip angel attachment: 0.375 inch diameter, hot dip galvanized expansion bolt embedded not less than 3 inches.
7. Welding: By certified welder.
8. Galvanizing: Comply with requirements of metal finishes specified.
9. Shop primer: Comply with metal finishes specified.

C. Provide fabricated open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Coordinate anchorages. Furnish setting drawings, templates, and anchorage structural loads for fastener resistance.

B. Do not begin installation until supporting structure is complete and ladder installation will not interfere with supporting structure work.

C. If supporting structure is the responsibility of another installer, notify Architect of unsatisfactory supporting work before proceeding.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions and in proper relationship with adjacent construction and as follows:
1. Anchor each clip angle with expansion bolts unless otherwise approved.
2. Install each fastener to support 300 load acting to cause greatest stress.
3. Install rungs, steps, landings and the like level.

B. Touch-up, repair or replace damaged products or finishes before Substantial Completion.

END OF SECTION

SECTION 06 08 00 - WOOD PRESERVATIVE & FIRE RETARDANT TREATMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section Includes, without limitation:
1. Preservative wood treatments.
2. Fire retardant wood treatments.

C. Related sections, without limitation, include:
1. Section 06 10 50 - Wood blocking.
2. Section 06 45 00 - Interior Wood Trim.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:
1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specifications, provide Fire retardant treatment products equal or superior to
1. Arch Chemicals Inc. “Dricon”
2. Hoover “Pyro-guard 3rd Generation Fire Retardent Treatment” - for dry interiors
3. Hoover "ExteriorFireX" for plywood only for damp interior and exterior applications.

4. Products shall be certified paintable or stainable.

2.2 PRESERVATIVE & FIRE RETARDANT TREATMENTS

A. Pressure Applied Preservative Treatment [PT]:
1. Material: ACQ – Alkaline Copper Quat, AWPA Standards P26, 27. 28. & 29.
2. Treatment Standard: AWPA C2 for lumber and C22 for panels.
3. Retention level: 0.25 lbs. per cubic foot; or
4. Moisture content: Kiln dried to 19% before delivery to job site.
5. Treated products shall conform to American Wood Preservers Bureau Standard LP-2 and be so stamped on each piece delivered.
6. Coordinate preservative treatment with roofing materials to ensure compatibility.
7. Fasteners used with PT: Hot dipped galvanized or stainless steel.
8. Use of electroplated fasteners: Not permitted.
9. Usage: Where shown and all plywood and lumber, exterior and interior, having direct contact with concrete or masonry and all blocking, nailing strips, curbs, wood battens and other wood embedded in or in contact with roofing.
10. Coatings: Coat concealed blocking to intended to abut sheet metal other than stainless steel with application of bituminous paint.

B. Fire Retardant Treatment [FRT]:
1. Standard: AWPA P17, formulations FR-1.
2. UL listed treatment adequate to achieve Class I rating with flame spread equal to 0-25 when tested in accordance with ASTM E84 and show no evidence of significant progressive combustion when test is continued for an additional 20 minutes. Provide treatments compatible with locations - interior or exterior.
3. Provide fire retardant treated wood products as shown or required by code.
4. I-2 Occupancies: Fire retardant treat all wood products.

C. Fire Retardant Plywood:
1. Class A material conforming to ASTM E-84, NFPA 255, UL 723.
2. Provide certification by manufacturer of conformity to standards.
3. Provide fasteners meeting manufacturers approval and requirements.
4. Acceptable manufacturer: Arch Chemicals Inc.,"Dricon FRT"

D. Water-Repellent Preservative: NWWDA tested and accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

2.3 APPLICATIONS

A. Pressure preservative treatments; provide as shown and including:
1. Treat above-ground wood exposed to deterioration by moisture
2. Wood in contact with the ground or fresh water.
3. Wood in contact with concrete or masonry.

B. Fire retardant treatments; provide as shown and including:
1. Where shown.
2. Where required by code.

C. High temperature fire retardant treatments; provide as shown and including:
1. Where shown.
2. Where required by code.
3. Enclosed roof framing.
4. Framing in attic spaces.

2.4 FIRE-RETARDANT-TREATED MATERIAL GENERAL REQUIREMENTS

A. Comply with the following:
1. Use treatment that does not promote corrosion of metal fasteners.

2. Exterior Type: Comply with requirements specified for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
4. For enclosed roof framing, framing in attic spaces, and where high temperature fire-retardant treatment is indicated, provide material with adjustment factors of not less than 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.]
5. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
6. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
7. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by testing agency].
8. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the provisions of Section 01 70 00 - especially requirements related to:
1. Inspection and examination.
2. Tolerances and measurement.
3. Approvals, inspections and filed quality control.
4. Protection.

B. Apply two coats of same preservative used in original treatment to all sawed or cut surfaces of treated lumber, in accordance with AWPA M4.

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.

END OF SECTION

SECTION 06 10 50 - WOOD BLOCKING

PART 1 - GENERAL

1.1 SUMMARY

A. All of Contract Documents, including Drawings, the General Conditions and Division 1 General Requirements apply to this Section.

B. Section includes, without limitation, providing:
1. Dimension lumber wood blocking.
2. Wood nailers, furring, sleepers and cants.
3. Strapping.
4. Priming, back-painting, and treating of field cuts.
5. Rough hardware.
6. Backerboards for electrical and telephone equipment.

C. Scope/extent includes, without limitation:
1. MEP, telephone, cable, and low voltage backer panels.
2. Wood fire stopping not provided by wood framing.
3. Wood curbs/timbers for roof-top components

D. Related Work includes, without limitation:
1. Section 06 08 00 - Wood preservative & fire retardant treatments.

1.2 SUBMITTALS

A. Product Data: Submit treatment manufacturers' and suppliers information on at least the following items and giving species, grades, actual sizes and moisture contents, finishes, and treatments as applicable
1. List of project wood and blocking products provided under this section.
2. List of fasteners and rough hardware by type, size, finish and typical applications for same

B. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY STANDARDS

A. Comply with the following:
1. Lumber Standards and Grade Stamps: PS 2/16, American Softwood Lumber Standard and inspection agency grade stamps.
2. Construction Panel Standards: PS 1, U.S. Product Standard for Construction and Industrial Plywood; APA PRP-108.
3. Fasteners and Nailing: Comply with Appendix C requirements of Massachusetts State Building Code, and as specified.
4. APA Design/Construction Guidelines.

B. Provide the following:
1. Official grade mark on lumber.
2. Mark of treating company certifying type of treatment applied on fire retardant treated and pressure preservative treated lumber and plywood.
3. American Plywood Association trade mark indicating type, grade and class of plywood panel.

1.4 PRODUCT DELIVERY AND STORAGE

A. Keep materials dry at all times. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber and plywood, and provide air circulation within stacks.

PART 2 - PRODUCTS

2.1 LUMBER & PLYWOOD

A. Moisture content: 15% max. for 2" or less nominal thickness, except as noted .

B. Surfacing: Use S4S material (surfaced four sides) free of warp, wanes and defects, unless specified otherwise.

C. Blocking species: No. 2 or better Douglas or Hem-Fir, or #2 Spruce Pine Fir, or, where plywood is indicated, use CDX waterproof glue APA exterior plywood.

D. 12 gage electrogalvanized sheet metal may be substituted for blocking at metal stud walls if sufficient strength is developed to support actual and code-mandated loads. Refer to other sections for requirements.

E. Blocking layout and size: Continuous and solid, fire retardant 3/4 inch plywood or fire retardant 2x4 or larger where additional support is required.

F. Provide blocking in addition to any indications on the drawings as follows:
1. Millwork attached to walls or ceilings.
2. Equipment attached to walls or ceilings.
3. At shelving and drapery track.
4. Mid points of wood stud walls.
5. Between wood joists at all points requiring support.

G. Wood fire stopping: Equal or better than blocking material. Do not use sheet metal for firestopping.

H. Provide firestopping as follows:
1. At ceiling lines and at 8'-0" height if ceiling is higher.
2. To close of all framing spaces connecting floors.
3. As required by code.

I. Provide fire retardant treated lumber where indicated, meeting the requirements for such plywood as given below. Provide fire retardant treated wood products as shown or required by code .

J. Furring: Solid wood sized to match the condition.

K. Strapping shall be 1" x 3.00" nom. solid wood stock, not less than 0.75 inch thick.

L. Bridging shall be 1" x 3" or approved galvanized steel cross bridging at intervals not to exceed 8'-0". Do not nail bottoms of bridging until subflooring is installed.

2.2 PLYWOOD

A. General: Provide only APA grade stamped softwood plywood meeting requirements of U.S. Dept. of Commerce PS-1 in thickness shown and in grades and strengths recommended by APA for specific locations and uses. Where indicated, provide preservative or fire retardant treatment.

B. Exposure: Exposure 1 or better.

C. Plywood backer panels:
1. Material: APA C-D Plugged Exposure 1 with exterior glue
2. Pressure treatment: Fire retardant.
3. Coatings: Fire retardant paint, 6 sides, applied before installation.
4. Coating color: As shown or directed, if not, black.
5. Thickness: As indicated, if not, 0.75 inches.

2.3 ROUGH HARDWARE

A. Furnish and install all bolts, nuts, expansion shields, lag screws, toggle bolts, wood screws, nails, flat cap metal nailing discs, staples, power driven anchors and other rough hardware as required.

B. Rough hardware items shall be of appropriate type and proper capacity and size as required for each specific application.

C. Concrete and masonry anchors: Where anchors are not included in concrete or masonry construction, anchors shall be galvanized machine screws or bolts with standard expansion-shield type concrete anchors, Phillips "Red Head" Masonry Anchors as manufactured by Weg-It Expansion Products, Inc., or approved equal, of sizes and types noted on Drawings or as required. Do not use expansion bolts or anchors where other type anchors are shown or noted on Drawings.

D. Power-driven fasteners: "Drive-It" system of Powder Power Tool Corporation, "Ramset" system of Ramset Fasteners, Inc., or equivalent system of Remington-DuPont may be used where approved by construction manager and Architect. Use washers with all inserts.

E. Fasteners used at treated wood:
1. Fasteners meeting manufacturers approval and requirements.
2. Where manufacturer specific recommendations are not available: Use stainless steel.

2.4 FIRE & PRESERVATIVE TREATMENT OF LUMBER & PLYWOOD

A. Wood treatment: Comply with requirements of Section 06 0800.

B. Extent for wood to be preservative treated: As shown and as follows:
1. Treat above-ground wood exposed to deterioration by moisture
2. Wood in contact with the ground or fresh water.
3. Wood in contact with concrete or masonry

C. Extent for wood to be fire retardant treated: As shown and as follows.
1. Exposed or semi-exposed wood in fire rated assemblies and in spaces having limited flame spreads for exposed combustibles.
2. Blocking concealed in fire rated assemblies
3. Where required by code.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the provisions of Section 01 70 00 - especially requirements related to:
1. Inspection and examination.
2. Tolerances and measurement.
3. Approvals, inspections and filed quality control.

3.2 MISCELLANEOUS CARPENTRY INSTALLATION - GENERAL REQUIREMENTS

A. Construct work plumb, level, and true, with tight, close fitting joints, securely attached and braced to surrounding construction all in a first-class workmanlike manner. Counter-bore for bolt heads, nuts, and washers where required to avoid interference with other materials.

B. Unless otherwise indicated, wood nailers, furring, strapping, etc., less than 2 in. nominal thickness shall be secured to back-up material by use of appropriate fasteners located 4 in. from ends and spaced not greater than 16 in. o.c. along lengths of members. Type and length of fastening devices shall develop sufficient anchorage to back-up material.

C. Where nailing or power-driving into concrete or masonry, avoid puncturing conduits, pipes, ducts, etc. embedded in such work.

D. Where anchorage to steel structural members is indicated, steel members will be prepared to receive anchor bolts, etc., as indicated, by structural steel trade.

E. Apply two coats of same preservative used in original treatment to all sawed or cut surfaces of treated lumber, in accordance with AWPA M4.

F. Power-driven fasteners used on concrete surfaces or at rough window and door openings shall be used in accordance with manufacturer's recommendations, especially in regard to edge distance, curbs or at rough window and door openings.

G. Do not space fasteners more than recommended or approved distances apart spacing and comply with applicable building codes, APA guide lines and best practices of the trade.

3.3 INSTALLATION OF BLOCKING AND NAILERS

A. Blocking: Locate blocking to facilitate installations of finish materials, fixtures and specialty items.

B. Attach Blocking as follows:
1. In metal stud partitions: Screw attach through stud flanges.
2. At masonry: With oval head toggle bolts and washers or with epoxy tube and sleeve systems.
3. At concrete: With expansion shield bolts.
4. At steel: With flat head bolts/nuts or approved power actuated fasteners.

C. Blocking shall be approved material capable of supporting items such as grab bars with a load of 250 lbs. for 5 minutes or more if so required by code. Provide fire retardant treated materials where indicated.

D. Blocking members shall be of the sizes indicated on the drawings not less than 3/4” plywood or lumber 3-1/2" wide unless otherwise noted on the drawings. Blocking members shall be secured with minimum of 5/16" galvanized steel bolts of sufficient length to provide a minimum of 3" of embedment in concrete or as required when bolting into steel members and as shown.

E. Bolts shall be located not over 2'-0" on centers and within 4" of end joints. End joints and intermediate joints shall be in alignment. Intermediate joints shall be spliced. Counterbore wood so that washer and nut, and end of bolt are recessed below the top surface of curbs and blocking. In no case shall there be less than two bolts per length in any member.

F. Nailers for wood trim and finish shall be provided and secured to the masonry, concrete, wood framing or other receiving surfaces as the work progresses. Nailers shall be not less than 1" nominal thickness and of such other dimensions and profiles as are required or shown.

G. Universal and barrier free design: Whether or not shown on the drawings, provide blocking for grab bars and other barrier free assemblies. Include the following:
1. Future grab bars for so-called group 1 and group 2 bathrooms:
   a. Water closets: Blocking adjacent to and behind water closets installed from 32 to 38 inches above finish floor; and 6 inches beyond water closet each side or to corner.
   b. Tubs: Blocking from 6 to 48 inches above tub rim, length and width of tub @ Group 1, to 60” above tub rim @ Group 2..
   c. Showers: Blocking from 6 to 48 inches above finish floor, full width, length of stall @ Group 1, to 60” above floor @ Group 2.
2. Indicated grab bars: As shown, if not, as above.

3.4 INSTALLATION OF FURRING AND STRAPPING

A. Furring and strapping at masonry walls to receive drywall shall be 16" o.c. unless otherwise shown. All furring and strapping shall be double nailed, secured to masonry or concrete with masonry nails.

B. All furring and strapping shall be shimmed and blocked to assure plumb and level furred wall surfaces.

3.5 INSTALLATION OF BACKER / UTILITY PANEL MOUNTS

A. Provide and install fire retardant plywood backings for surface mounted electric panel boards, meter mounts, protection cabinets, motor control panels and the like. Boards shall be rigidly built and securely fastened to wood-furred strapping at walls in approved manner. See Electrical Drawings for locations of devices which require mounting on backerboards. Provide plywood backings for Telephone and Protection (Security) panels.

3.6 CLEAN UP & PROTECTION

A. Clean up work areas daily, remove packaging, debris, sawdust and scraps, and dispose of properly.

B. Repair or replace work of other trades damaged or soiled as a result of work of this Section.

C. Protect substrates, underlayments, finishes and other work subject to damage until installation of work by the next trade.

END OF SECTION

SECTION 06 16 15 – COMPOSITE NAIL BASE INSULATING SHEATHING FOR FRAMED WALLS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section Includes, without limitation, providing:
1. Composite nail base insulating sheathing.

C. Extent: As shown, including use as substrate for cement fiber siding.

D. Related Requirements:
1. Division 06 – Other sheathing types.
2. Division 07 – Other air/water barriers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

B. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Provide wall sheathing products meeting requirements for water-resistive barrier in accordance with ICC-ES AC310.

B. Provide wall sheathing products meeting requirements of ICC-ES AC269.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof, vented sheeting, securely anchored. Provide for air circulation around stacks and under coverings. Protect from sunlight and UV radiation.

1.5 WARRANTY

A. Special Manufacturer's Warranty: Manufacturer's standard form in which sheathing manufacturer agrees to repair or replace sheathing products that demonstrate deterioration or failure under normal use due to manufacturing defects within warranty period specified, when installed according to manufacturer's instructions.
1. Warranty Period for Sheathing Products: 30 years following date of Substantial Completion.

B. Warranty Conditions: Special warranties exclude deterioration or failure due to structural movement resulting in stresses on sheathing products exceeding manufacturer's written specifications, or due to air or moisture infiltration resulting from cladding failure or mechanical damage.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Where shown, at fire rated assemblies, provide materials and construction identical to tested assemblies, including:
1. UL's "Fire Resistance Directory."
2. GA-600, "Fire Resistance Design Manual."
3. NFPA 285.
4. Span ratings: Comply with Division 06 – Rough Carpentry section.

2.2 COMPOSITE NAIL BASE INSULATING OSB SHEATHING WITH INTEGRATED AIR/MOISTURE BARRIER

A. Type 1 Not vented:
1. Manufacturers: Subject to compliance with requirements, include the following]:
   a. Huber Engineered Woods; www.zipsystem.com/.
   b. Georgia Pacific “ForceField”; www.buildgp.com/.
   c. LP WeatherLogic; www.lpcorp.co/.
   d. Approved equal.
2. Basis of Design: Huber “Zip System R Sheathing Wall Sheathing”, as follows:
   a. Oriented-strand-board Exposure 1 sheathing thickness, with factory-laminated water-resistive barrier exterior facer, and with rigid foam plastic insulating board laminated to interior face.

B. Materials:
1. Span Rating and Performance Category of Sheathing Layer: Not less than 24/16; 7/16 Performance Category.
2. Edge Configuration: Square finished.
3. Oriented Strand Board: Comply with the following:
   a. Standard: DOC PS 2.
   b. Binder: Containing no added urea formaldehyde.
   c. Thickness: As shown, if not 7/16 inch.
   d. Performance for 7/19: 24/16 span rating.
4. Insulating board: Rigid polyisocyanurate foam core with coated glass fiber facers on both sides, and the following characteristics:
   a. Standard: ASTM C1289 Type II, Class 2, and ICC-ES AC12.
   b. Thickness: As shown, if not, provide: .
      1) 2 inches at punched window side panels with R value of 9 or better.
      2) 2.5 inches at all other locations with R value of 12.6 or better.
      3) Nominal Density: 2.0 pcf (32 kg/cu. m).
      4) Compressive Strength, ASTM D1621: Not less than 20 psi (150 kPa).
      5) Vapor Permeance, ASTM E96/E96M: Less than 1.0 perm.
5. Exterior Facer: Medium-density, phenolic-impregnated polymer-modified sheet material meeting requirements for ASTM D779 Grade D weather-resistive barrier in accordance with ICC AC38 and AC310, with fastener spacing symbols on exterior facer for and on center spacing, with the following characteristics
   a. Water Resistance of Coatings, ASTM D2247: Pass 14 day exposure test.
   b. Moisture Vapor Transmission, ASTM E96: Not less than 12 perms.
   c. Water Penetration, ASTM E331: Pass at 2.86 lbf/sq. ft. (137 Pa).
   d. Wind Driven Rain, TAS-100: Pass.
   e. Accelerated Weathering, ASTM G154: Pass.

2.3 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified and as recommended by manufacturer.
1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A or provide Type 304 stainless steel.
2. Nails, Spikes: ASTM F 1667.
3. Power-Driven Fasteners: NES NER-272 or ICC-ES-1539
4. Wood Screws: ASME B18.6.1.

B. Fasteners for concrete masonry units, concrete or steel studs:
1. Acceptable product: Hunter Panel SIP SD Fastener. HD fastener may be used at steel studs only.
2. Type: Mechanically fastened star/spider head coated screw, not less than 3/16 inch shank.
3. Coating: Corrosion resistant coated, hot dip galvanized or solid stainless steel.
4. Plates: Only if required by FM.
5. Pre-drilling studs: Normally not required.
6. Pre-drilling concrete or masonry: Required.
7. Penetration: As recommended by manufacturer for application, normally 1 inch or more.

C. Fasteners for wood studs:

1. Acceptable product: Hunter Panel SIP WD Fastener.
2. Type: Mechanically fastened star/spider head coated screw, not less than 3/16 inch shank.
3. Coating: Corrosion resistant coated, hot dip galvanized or solid stainless steel.
4. Plates: Only if required by FM.
5. Penetration: As recommended by manufacturer for application, normally 1.5 inch or more.

D. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
1. For wall and roof sheathing panels, provide screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

E. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.
1. For steel framing less than 0.0329 inch (0.835 mm) thick, use screws that comply with ASTM C 1002.
2. For steel framing from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick, use screws that comply with ASTM C 954.

2.4 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant: As recommended by manufacturer, such as: silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing.

B. Self-Adhering Seam and Flashing Tape: Pressure-sensitive, self-adhering, cold-applied, seam tape consisting of polyolefin film with acrylic adhesive, meeting ICC AC148.
1. Basis-of-Design Product: Huber Engineered Woods; ZIP System Tape.
2. Thickness: 0.012 inch (0.3 mm).

PART 3 - EXECUTION

3.1 EXECUTION, GENERAL

A. Comply with the provisions of Section 01 70 00 - including requirements related to:
1. Inspection and examination. Tolerances and measurement.
2. Approvals, inspections and filed quality control.
3. Layout. Adjusting.
4. Cleaning. Protection.

3.2 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. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."

A. At wood framing: Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

B. At metal stud framing: Use specified screws with penetration per standards.

C. At metal deck: Use approved fasteners over metal deck, not less than 1 fastener per square foot.

D. Coordinate wall and 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.
   1. Air and Moisture Barrier: Coordinate sheathing installation with flashing and joint sealant installation and with adjacent building air and moisture barrier components to provide complete, continuous air- and moisture-barrier.

E. Install panels with laminated facer to exterior. Stagger end joints of adjacent panel runs.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast. Tape polyiso foam edges which may be exposed to sunlight for 60 days or more with compatible waterproof tape.

H. Apply seam tape at all panel seams, penetrations, and facer defects or cracks to form continuous weathertight surface. Apply tape according to manufacturer's written instructions and requirements of ICC-ES applicable to tape application.

END OF SECTION

SECTION 06 40 20 - INTERIOR ARCHITECTURAL MILLWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Millwork assemblies not provided under other sections.

1.2 SUBMITTALS

A. Comply with provisions of Division 1 and submit:
1. Product Data: Submit manufacturer's specifications and installation instructions for each item of factory-fabricated woodwork.
2. Shop Drawings: Submit shop drawings on all items of finish carpentry and architectural woodwork. Show all significant details of materials, construction, and installation.
3. Office Samples: Submit samples of all woodwork and millwork materials and sample portions of fabricated items to Architect for approval. Sample finish applied on one side and one edge.
4. Fire-Retardant Materials: Include manufacturer's instructions for handling, storing and installation of fire-retardant treated material.
5. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. All material provided shall be graded in accordance with the following standards:
1. Softwood lumber: U.S. Dept. of Commerce PS20.
2. Softwood plywood: U.S. Dept. of Commerce PS1.
3. Hardwood lumber: Comply with National Hardwood Lumber Association (NHLA) rules.
4. Hardwood plywood: Comply with PS-51, and ANSI/HPVA HP-1-2004 American National Standard for Hardwood and Decorative Plywood

B. All lumber provided shall bear an official grade mark specifying the species or species grouping, grade, grading agency, mill number or name and condition of seasoning at time of manufacture. However, omit grade marks from surfaces which will be exposed and which will receive a transparent or opaque finish.

C. Softwood plywood panels shall bear the appropriate American Plywood Association grade mark indicating type, grade and class of the panel.

D. Finish Carpentry Standards:
1. The "Quality Standards" of the Architectural Woodwork Institute shall apply and by reference are hereby made a part of this specification. Any reference to Premium or Custom in this specification shall be as defined in the latest edition of the AWI "Quality Standards." If not indicated, provide Premium.

E. Field Dimensions:
1. Verify actual dimensions of areas to receive shop fabricated woodwork by taking field dimensions.
2. Show field dimensions on final shop drawings.
3. Build shop fabricated work to fit field conditions.

F. Fire-Retardant Marking and Treatments: Comply with wood treatment section and building code.

1.4 PRODUCT DELIVERY AND STORAGE

A. Protect finish carpentry materials during transit, delivery, storage and handling to prevent damage, soiling and deterioration. Comply with Division 01.

1.5 JOB CONDITIONS

A. Conditioning: Installer shall advise persons or companies having responsibility for temporary facilities of temperature and humidity requirements in areas to receive finish carpentry. Do not install finish carpentry until required temperature and relative humidity have been stabilized and will be maintained in installation areas.

B. Maintain temperature and humidity in installation area as required to maintain moisture content of installed finish carpentry within acceptable industry standard tolerance of optimum moisture content, from date of installation through remainder of construction period. The fabricator of woodwork shall determine optimum moisture content and required temperature and humidity condition.

PART 2 - PRODUCTS

2.1 FIRE RETARDANT TREATMENTS

A. Where required by code, provide fire retardant treated materials meeting Class A conforming to ASTM E84.

2.2 MATERIALS – GENERAL

A. Provide materials complying with the following:
1. Solid lumber: AWI Section 100, and per specified grades, if not indicated, Premium.
2. Hardboard: AHA A135.4.
3. Medium-Density Fiberboard: ANSI A208.2, Grade 130, made with binder containing no urea formaldehyde.
4. Particleboard: ANSI A208.1, Grade M-2 .
5. Softwood Plywood: DOC PS 1.
6. Hardwood Plywood and Face Veneers: HPVA HP-1, made with adhesive containing no urea formaldehyde].
7. Thermoset Decorative Panels: Comply with LMA SAT - 1.

2.3 TRANSPARENT FINISH LUMBER & VENEER PANELS

A. Quality Standard: AWI Premium grade materials and workmanship.

B. For hardwood veneer panels, provide:
1. Core: Lumber core or MDF core.
2. Plywood panel Construction: 5 ply
3. Face veneer Species: As shown.
4. Face veneer cut: Rift sawn.
5. Face veneer Grade AWI Premium Grade
6. Matching: subject to Architect's review prior to laminating panels.

C. Solid Lumber: At corners, edges and elsewhere as detailed provide solid lumber to match adjacent veneer. Tape is acceptable at reveals when shown on drawings.

2.4 MISCELLANELEOUS MATERIALS

A. Furring: Fire-retardant treated wood strapping to support wood paneling where required by code or shown.

B. Firestopping & retardant treatments: Firestop between furring with USG "Thermafiber" mineral fiber fire safing insulation. Provide fire retardant treatments where required by code, authorities having jurisdiction and to prevent concealed spaces in excess of 96 inches horizontally or vertically allowing spread of concealed flame or fire.

2.5 MDF CORE MATERIALS

A. Medium-density fiberboard: Substrates required to be medium density fiberboard shall comply with ANSI a208.2, grade MD-exterior glue and contain no added formaldehyde and not exceed required formaldehyde out-gassing limits.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the surfaces to receive the work of this Section before proceeding with installation. Do not proceed with installation until all unsatisfactory conditions which would impair the work have been corrected. Notify the construction manager in writing of the conditions which would impair the proper and timely completion of the work. Starting work constitutes acceptance of conditions.

3.2 PREPARATION

A. Condition work to average prevailing humidity conditions in installation areas prior to installing.

B. Deliver concrete inserts and similar anchoring devices to be built into substrates, well in advance of time substrates are to be built.

C. Prior to installation, examine shop fabricated work for completion, and complete work as required, including back priming and removal of packing.

3.3 FABRICATION

A. Finished woodwork shall be dressed and sanded until free from machine and tool marks, abrasions, raised grain, or other defects on surfaces exposed to view. Construction and workmanship shall conform to, or exceed, the requirements of "Premium Grade" as defined in the latest edition of the AWI "Quality Standards."

3.4 PRIMING & SEALING

A. Do not install materials on the exterior until coated on six sides. Priming shall be provided in accordance with the requirements of Division 06 00 00 and 09 00 00. Seal backs and concealed portions of shop coated work.

3.5 INSTALLATION -- GENERAL

A. Install work plumb, level, true and straight with no distortions. Shim as required using concealed shims, and as follows:
1. Install fabricated work to AWI 1700, meeting the requirements for the specified grade.
2. Scribe and cut work to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.
3. Secure work to anchors or blocking built-in or directly attached to substrates.
4. Secure to grounds, strapping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation.
5. Except where prefinished matching fasteners heads are required, use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork, and matching final finish where transparent finish is indicated.

3.6 ADJUSTMENT, CLEANING, FINISHING AND PROTECTION

A. Repair damaged and defective work wherever possible to eliminate defects functionally and visually; where not possible to repair properly, replace cabinets. Comply with the following:
1. Clean hardware, lubricate and make final adjustments for proper operation.
2. Clean exposed and semi-exposed surfaces. Touch- up shop-applied finishes to restore damaged or soiled areas.
3. Repair or replace work other trades damaged or soiled by the work of this Section.

4. Complete finishing work specified as work of this section, to whatever extent not completed at shop or prior to installation. Refer to Section 09900 for finish systems to be used.
5. Protect work during remainder of construction period to ensure that work will be without damage or deterioration at time of acceptance.
6. Keep work areas clean by daily sweeping and disposal of scrap ,sawdust and debris.

END OF SECTION

SECTION 06 41 12 - WOOD VENEER FACED ARCHITECTURAL CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Wood veneer faced architectural casework.
2. ADA and FHA accessibility requirements.

C. Related requirements, without limitation, include:
1. Section 06 08 00 Wood preservative & fire retardant treatments
2. Section 06 10 50 Wood blocking.
3. Section 06 41 16 Plastic laminate faced architectural casework
4. Section 06 41 25 Hardware for architectural casework
5. Section 06 46 00 Interior wood trim.
6. Section 12 36 25 - Plastic laminate countertops.:
7. Section 12 36 62 - Solid surface countertops.

1.2 QUALITY ASSURANCE

A. All material provided shall be graded in accordance with the following standards:
1. Softwood lumber: U.S. Dept. of Commerce PS20.
2. Softwood plywood: U.S. Dept. of Commerce PS1.
3. Hardwood lumber: Comply with National Hardwood Lumber Association (NHLA) rules.
4. Hardwood plywood: Comply with PS-51, and ANSI/HPVA HP-1-2004 American National Standard for Hardwood and Decorative Plywood
5. Forest Stewardship Council: FSC 1.2 - Principles and Criteria.

B. All lumber provided shall bear an official grade mark specifying the species or species grouping, grade, grading agency, mill number or name and condition of seasoning at time of manufacture. However, omit grade marks from surfaces which will be exposed and which will receive a transparent or opaque finish.

C. Softwood plywood panels shall bear the appropriate American Plywood Association grade mark indicating type, grade and class of the panel.

D. Finish Carpentry Standards:
1. The "Quality Standards" of the Architectural Woodwork Institute shall apply and by reference are hereby made a part of this specification. Any reference to Premium or Custom in this specification shall be as defined in the latest edition of the AWI "Quality Standards."
2. AWI Quality Marking: Mark each assembled unit of architectural woodwork with manufacturer's identification and grade mark evidencing compliance with indicated AWI quality grade. Locate grade mark on surfaces which will not be exposed after installation. For other items requiring field assembly, a certification of compliance may be substituted for marking of individual pieces.

E. Field Dimensions:
1. Verify actual dimensions of areas to receive shop fabricated woodwork by taking field dimensions.
2. Show field dimensions on final shop drawings.
3. Build shop fabricated work to fit field conditions.

F. Fire-Retardant Marking and Treatments: Comply with Section 06 08 00.

G. Comply with applicable provisions of standards accessibility requirements affecting the project, including:
1. State Architectural Access Board regulations, but only as they apply to types of baths and kitchens required for this project.

1.3 SUBMITTALS

A. Comply with provisions of Division 1 and submit:

B. Shop Drawings: Submit shop drawings on all items of finish carpentry and architectural woodwork. Show all significant details of materials, construction, and installation.

C. Office Samples: Submit samples of all woodwork and millwork materials and sample portions of fabricated items to Architect for approval. Samples shall be approximately 12 inches square, and shall include each wood species which is to receive transparent finish at job site, and each finish to be applied at factory. Sample finish applied on one side and one edge.

D. Product Data: Submit manufacturer's specifications and installation instructions for each item of factory- fabricated woodwork.

E. Fire-Retardant Materials: Include manufacturer's instructions for handling, storing and installation of fire-retardant treated material.

F. Quality Certification: Submit manufacturer's (Fabricator's) certification, stating that the fabricated work complies with quality grades and other requirements indicated.

G. Certification: Include certification that fire-retardant treated materials comply with requirements indicated.

H. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.4 SUSTAINABILITY REQUIREMENTS AND SUBMITTALS

A. Comply with Division 01.

B. VOC Content: Submit printed statements from manufacturers of VOC content of adhesives, sealers and coatings used under this section.

C. Urea Formaldehyde: Submit manufacturer’s product data evidence that no urea formaldehyde is contained in products used in this section including the following:
1. Composite wood bonding agents.
2. Adhesives.
3. Panel products.

1.5 PRODUCT DELIVERY AND STORAGE

A. Protect finish carpentry materials during transit, delivery, storage and handling to prevent damage, soiling and deterioration.

B. Do not deliver finish carpentry materials, until painting, wet work, grinding and similar operations which could damage, soil or deteriorate woodwork have been completed in installation areas. If, due to unforeseen circumstances, finish carpentry materials must be stored in other than installation areas, store only in areas meeting requirements specified for installation areas.

C. Store all materials off the floor, fully protected from damage of all types.

1.6 JOB CONDITIONS

A. Conditioning: Installer shall advise persons or companies having responsibility for temporary facilities of temperature and humidity requirements in areas to receive finish carpentry. Do not install finish carpentry until required temperature and relative humidity have been stabilized and will be maintained in installation areas.

B. Maintain temperature and humidity in installation area as required to maintain moisture content of installed finish carpentry within acceptable industry standard tolerance of optimum moisture content, from date of installation through remainder of construction period. The fabricator of woodwork shall determine optimum moisture content and required temperature and humidity condition.

PART 2 - PRODUCTS

2.1 FIRE RETARDANT TREATMENTS

A. Where required by code, provide fire retardant treated materials meeting Class A conforming to ASTM E84.

2.2 MATERIALS – GENERAL

A. Provide materials complying with the following:
1. Solid lumber: AWI Section 100, and per specified grades, if not indicated, Premium.
2. Hardboard: AHA A135.4.
3. Medium-Density Fiberboard: ANSI A208.2, Grade 130, made with binder containing no urea formaldehyde.
4. Particleboard: Not permitted.
5. Softwood Plywood: DOC PS 1.
6. Hardwood Plywood and Face Veneers: HPVA HP-1, made with adhesive containing no urea formaldehyde].
7. Thermoset Decorative Panels: Comply with LMA SAT - 1.
8. Hybrid, combinations MDF face with plywood core: Meeting “Pioppo-MDF” product standards.

2.3 TRANSPARENT FINISH LUMBER & VENEER MATERIALS

A. Quality Standard: AWI Premium grade materials and workmanship.

B. For hardwood veneer panels, provide:
1. Core: Lumber core or MDF core.
2. Plywood panel Construction: 5 ply
3. Face veneer Species: As shown, if not, Wood type 1 per Section 06 06 02 Interior wood types.
4. Face veneer cut: Rift sawn.
5. Face veneer grade: As indicated, if not, AA.
6. Matching: subject to Architect's review prior to laminating panels.

C. Solid Lumber: At corners, edges and elsewhere as detailed provide solid lumber to match adjacent veneer. Tape is acceptable at reveals when shown on drawings.

2.4 MISCELLANEOUS MATERIALS

A. Furring: Fire-retardant treated wood strapping to support wood panels or casework where required by code or shown.

B. Firestopping & retardant treatments: Firestop between furring with "Thermafiber" mineral fiber fire safing insulation. Provide fire retardant treatments where required by code, authorities having jurisdiction and to prevent concealed spaces in excess of 96 inches horizontally or vertically allowing spread of concealed flame or fire.

2.5 MDF CORE MATERIALS

A. Medium-density fiberboard: Substrates required to be medium density fiberboard shall comply with ANSI a208.2, grade MD-exterior glue and contain no added formaldehyde and not exceed required formaldehyde out-gassing limits.
1. Hybrid, combinations MDF face with plywood core: Meeting “Pioppo-MDF” product standards.

2.6 METAL TRIM & PANELS

A. Panels, base and trim:
1. Manufacturers/products:
a. Rimex Metals Group; www.rimexmetals.com/.
b. Approved equal.
2. Basis of design: Granex M1A, a bead blast medium finish.
3. Material: Type 304 stainless steel.

4. Thickness:
   a. Sheet material: 1.5 mm
   b. Extruded material: 0.060 inch.
5. Shapes, sizes and profiles: As shown.
6. Lengths: Minimize seams; locate only where shown or approved by Architect.
7. Corners: Tight miters, free of burrs.
8. Attachment: As indicated, if not, concealed adhesives.

B. Aluminum extruded channels: Continuous style pulls and trim:
1. Aluminum trim: Extruded aluminum U and J channels, by Julius Blum & Co. or equal. Sizes as indicated and required, if not shown, 1 inch deep, 3 inch high.
2. Finish: As shown, if not, clear anodized aluminum.

C. Adhesives: as recommended by manufacturer. Use waterproof type at utility, food preparation, sink area, vanity and where ever materials may come in contact with water vapor or liquid.

2.7 TRASH & RECYCLING BINS

A. Provide units shown, as manufactured by Rubbermaid including:
1. Rigid liner trash bin: Model No. 3958; size 19.5 x 19.5 x 27.375 inches.
2. Rigid liner recycling container: Model No. 3958-73; size 16.5 x 15.5 x 30.9 inches.
3. Recycling container: Model No. 3569-73; size 14.5 x 14.5 x 28 inches.
4. Trash container: Model No. 3569-88; size 16.5 x 15.5 x 30.95 inches.
5. Recycling container: Model No. 2957-73; size 11 x 15.25 x 19.875 inches.

2.8 COUNTERTOPS

A. Refer to Division 12 .

2.9 TRANSPARENT FINISH CASEWORK - TYPE 1

A. Casework/Cabinetry:
1. AWI 400A quality grade: Premium AWI grade selection includes quality of workmanship and materials.
2. Construction. Details shall conform to Flush overlay design.
3. Frame: Frameless, European style box construction.
4. Drawer box construction: Dovetail box with applied face
5. Exposed parts wood species: Refer to Section 06 06 02 Interior wood types.
6. Semi-exposed parts: As governed by selected AWI quality grade.
7. Support shelving off let-in solid brass tab supports securely mounted to end wall panel holes spaced 2 inches on center.
8. Hardware: As specified below.

B. Usage: Where shown.

C. Accessibility: Comply with accessibility requirements, removal fronts, other ADA, state code accessibility requirements.
1. Accessibility Construction Condition 1: Fronts and base cabinet bottoms shall be removable to leave all exposed areas with “full exposure” finishes.
2. Accessibility Construction Condition 2: Fronts and base cabinet shall be undercut or assembled to provide required clearances.

2.10 CASEWORK HARDWARE MATERIALS

A. General: Provide cabinet hardware and accessory materials associated with work. .

B. Refer to Section 06 41 25 Hardware For Architectural Casework.

2.11 ROUGH HARDWARE AND NAILS

A. Provide all rough hardware required to complete the work using concealed fastenings wherever possible. In general, concealed fastenings shall be bright steel, except that at exterior areas they shall be galvanized steel, non-ferrous, or stainless steel. All exposed fastenings in all locations shall be non-ferrous or stainless steel as selected or approved in each case by the Architect.

2.12 BACKPRIMING & SEALING MATERIALS

A. Work that is shop fabricated and not accessible for field priming or sealing shall be primed and/or sealed under this section.

B. Use materials compatible with final finishes and the requirements of section 09900.

2.13 SHOP FINISHES

A. Provide shop finishes for all work of this section complying with the requirements for opaque and transparent finishes specified in section 09 90 10. Work for opaque finishes is to primed. Work for transparent finishes is to be sealed only when no practical alternative to complete shop finishing is available; all other work for transparent finish is to fully finished in the shop. Touch up defects in final shop finishes under the work of this section.

B. Transparent shop finishes shall match doors. The intent of the work is that all transparent finish of casework, paneling, counters, trim, and the like match the transparent finish of the doors. Provide the coordination necessary to achieve this result.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the surfaces to receive the work of this Section before proceeding with installation. Do not proceed with installation until all unsatisfactory conditions which would impair the work have been corrected. Notify the construction manager in writing of the conditions which would impair the proper and timely completion of the work. Starting work constitutes acceptance of conditions.

3.2 PREPARATION

A. Condition work to average prevailing humidity conditions in installation areas prior to installing.

B. Deliver concrete inserts and similar anchoring devices to be built into substrates, well in advance of time substrates are to be built.

C. Prior to installation, examine shop fabricated work for completion, and complete work as required, including back priming and removal of packing.

3.3 FABRICATION

A. Finished woodwork shall be dressed and sanded until free from machine and tool marks, abrasions, raised grain, or other defects on surfaces exposed to view. Construction and workmanship shall conform to, or exceed, the requirements of "Premium Grade" as defined in the latest edition of the AWI "Quality Standards."

B. Joints shall be tight and so formed as to conceal shrinkage. Mortise and tenon joints shall be set in glue under pressure. Shop miters four inches or greater shall be glued and doweled or locked with metal splice. Miters less than four inches shall be glued and splined with the spline concealed.

C. All exposed sides and ends of plywood shall be edged with solid strip of matching hardwood, at least 1/2 inch thick, and the full width of the plywood edge. Miter edge strips at corner.

D. All nails in finished work shall be blind nailed wherever possible and surface nails shall be set and filled with matching plastic wood.

E. Woodwork shall be properly framed, closely fitted and accurately set to the required lines and levels and shall be rigidly secured in place.

F. All finish work shall be sandpapered at field joints and where required by installation and shall be left in perfect condition for finishing.

3.4 PRIMING & SEALING

A. Do not install materials on the exterior until coated on six sides. Priming shall be provided in accordance with the requirements of Section 09 90 10. Seal backs and concealed portions of shop coated work.

3.5 INSTALLATION -- GENERAL

A. Install work plumb, level, true and straight with no distortions. Shim as required using concealed shims.

B. Install fabricated work to AWI 01 7 000, meeting the requirements for the specified grade.

C. Scribe and cut work to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.

D. Secure work to anchors or blocking built-in or directly attached to substrates. Secure to grounds, strapping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where prefinished matching fasteners heads are required, use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork, and matching final finish where transparent finish is indicated.

E. Casework: Install without distortion so that panels, doors and drawers fit properly, accurately, and fully aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

3.6 ADJUSTMENT, CLEANING, FINISHING AND PROTECTION

A. Repair damaged and defective work wherever possible to eliminate defects functionally and visually; where not possible to repair properly, replace cabinets.

B. Clean hardware, lubricate and make final adjustments for proper operation.

C. Clean exposed and semi-exposed surfaces. Touch- up shop-applied finishes to restore damaged or soiled areas.

D. Repair or replace work other trades damaged or soiled by the work of this Section.

E. Complete finishing work specified as work of this section, to whatever extent not completed at shop or prior to installation. Refer to Section 09 90 00 for finish systems to be used.

F. Protect work during remainder of construction period to ensure that work will be without damage or deterioration at time of acceptance.

G. Keep work areas clean by daily sweeping and disposal of scrap ,sawdust and debris.

END OF SECTION

SECTION 06 41 16 - PLASTIC LAMINATE FACED ARCHITECTURAL CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Plastic laminate custom architectural casework.
2. ADA and FHA accessibility requirements.

C. Related requirements, without limitation, include:
1. Section 06 06 10 Sustainable wood use requirements
2. Section 06 08 00 Wood preservative & fire retardant treatments
3. Section 06 10 50 Wood blocking.
4. Section 06 41 12 Wood veneer faced architectural casework
5. Section 06 41 25 Hardware for architectural casework
6. Section 12 36 25 Plastic laminate countertops
7. Section 12 36 62 Solid surface countertops

1.2 QUALITY ASSURANCE

A. All material provided shall be graded in accordance with the following standards:
1. Softwood lumber: U.S. Dept. of Commerce PS20.
2. Softwood plywood: U.S. Dept. of Commerce PS1.
3. Hardwood lumber: Comply with National Hardwood Lumber Association (NHLA) rules.
4. Hardwood plywood: Comply with PS-51, and ANSI/HPVA HP-1-2004 American National Standard for Hardwood and Decorative Plywood
5. Forest Stewardship Council: FSC 1.2 - Principles and Criteria.

B. All lumber provided shall bear an official grade mark specifying the species or species grouping, grade, grading agency, mill number or name and condition of seasoning at time of manufacture. However, omit grade marks from surfaces which will be exposed and which will receive a transparent or opaque finish.

C. Softwood plywood panels shall bear the appropriate American Plywood Association grade mark indicating type, grade and class of the panel.

D. Finish Carpentry Standards:
1. The "Quality Standards" of the Architectural Woodwork Institute shall apply and by reference are hereby made a part of this specification. Any reference to Premium or Custom in this specification shall be as defined in the latest edition of the AWI "Quality Standards."
2. AWI Quality Marking: Mark each assembled unit of architectural woodwork with manufacturer's identification and grade mark evidencing compliance with indicated AWI quality grade. Locate grade mark on surfaces which will not be exposed after installation. For other items requiring field assembly, a certification of compliance may be substituted for marking of individual pieces.

E. Field Dimensions:
1. Verify actual dimensions of areas to receive shop fabricated woodwork by taking field dimensions.
2. Show field dimensions on final shop drawings.
3. Build shop fabricated work to fit field conditions.

F. Fire-Retardant Marking and Treatments: Comply with Section 06 08 00.

G. Comply with applicable provisions of standards accessibility requirements affecting the project, including:
1. State Architectural Access Board regulations but only as they apply to types of baths and kitchens required for this project.

1.3 SUBMITTALS

A. Comply with provisions of Division 1 and submit:
1. Shop Drawings: Submit shop drawings on all items of finish carpentry and architectural woodwork. Show all significant details of materials, construction, and installation. Office Samples: Submit samples of all woodwork and millwork materials and sample portions of fabricated items to Architect for approval. Samples shall be approximately 12 inches square, and shall include each wood species which is to receive transparent finish at job site, and each finish to be applied at factory. Sample finish applied on one side and one edge.
3. Product Data: Submit manufacturer's specifications and installation instructions for each item of factory-fabricated woodwork.
4. Fire-Retardant Materials: Include manufacturer's instructions for handling, storing and installation of fire-retardant treated material.
5. Quality Certification: Submit manufacturer's (Fabricator's) certification, stating that the fabricated work complies with quality grades and other requirements indicated.
6. Certification: Include certification that fire-retardant treated materials comply with requirements indicated.

B. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.4 PRODUCT DELIVERY AND STORAGE

A. Protect finish carpentry materials during transit, delivery, storage and handling to prevent damage, soiling and deterioration.

B. Do not deliver finish carpentry materials, until painting, wet work, grinding and similar operations which could damage, soil or deteriorate woodwork have been completed in installation areas. If, due to unforeseen circumstances, finish carpentry materials must be stored in other than installation areas, store only in areas meeting requirements specified for installation areas.

C. Store all materials off the floor, fully protected from damage of all types.

1.5 JOB CONDITIONS

A. Conditioning: Installer shall advise persons or companies having responsibility for temporary facilities of temperature and humidity requirements in areas to receive finish carpentry. Do not install finish carpentry until required temperature and relative humidity have been stabilized and will be maintained in installation areas.

B. Maintain temperature and humidity in installation area as required to maintain moisture content of installed finish carpentry within acceptable industry standard tolerance of optimum moisture content, from date of installation through remainder of construction period. The fabricator of woodwork shall determine optimum moisture content and required temperature and humidity condition.

PART 2 - PRODUCTS

2.1 FIRE RETARDANT TREATMENTS

A. Where required by code, provide fire retardant treated materials meeting Class A conforming to ASTM E84.

2.2 MATERIALS – GENERAL

A. Provide materials complying with the following:
1. Solid lumber: AWI Section 100, and per specified grades, if not indicated, Premium.
2. Hardboard: AHA A135.4.
3. Medium-Density Fiberboard: ANSI A208.2, Grade 130, made with binder containing no urea formaldehyde.

4. Particleboard: [ANSI A208.1, Grade M-2] [Straw-based particleboard complying with requirements of ANSI A208.1, Grade M-2, except for density].
5. Softwood Plywood: DOC PS 1.
6. Thermoset Decorative Panels: Comply with LMA SAT - 1.

2.3 PLASTIC LAMINATE COVERED CASEWORK

A. Comply with the following:
1. Grade: Provide casework conforming to AWI "Premium Grade" requirements, Section 400.
2. Construction: Provide casework conforming to AWI "Full Flush Overlay" details as shown in AWI publication Architectural Casework Details. Cases shall be frameless type.
3. Plastic Laminates: As specified.
4. Finish all exposed, semi-exposed and interior surfaces with laminate. Provide backing sheets on opposite faces.
5. Provide loose splashes with six sides covered with laminate.
6. Drawer construction: Multiple dovetail construction with applied drawer front.
7. Casework joinery: Fabricate countertops and casework to have fewest possible seams. Locate seams where shown on shop drawings and approved by Architect. Do not use exposed fasteners or connectors. Use concealed bolts to hold seams and joints hairline, lightproof tight.
8. Exposed surfaces: Covered with “face” laminate.
9. Dust panels: Provide plywood dust panels in work.
10. Blocking and Brackets: Loading capacity shall be as follows:
    a. Shelves: 50 lbs. per linear foot.
    b. Countertops: 50 lbs. per linear foot plus a 250 lb. concentrated load at center span.
11. Accessibility: Comply with requirements of Section 12 35 30 for accessibility, removal fronts, other ADA, Mass AAB requirements.

2.4 MISCELLANEOUS MATERIALS

A. Furring: Fire-retardant treated wood strapping to support panels or casework where required by code or shown.

B. Firestopping & retardant treatments: Firestop between furring with "Thermafiber" mineral fiber fire safing insulation. Provide fire retardant treatments where required by code, authorities having jurisdiction and to prevent concealed spaces in excess of 96 inches horizontally or vertically allowing spread of concealed flame or fire.

2.5 MDF CORE MATERIALS

A. Medium-density fiberboard: Substrates required to be medium density fiberboard shall comply with ANSI a208.2, grade MD-exterior glue and contain no added formaldehyde and not exceed required formaldehyde out-gassing limits.

2.6 PLASTIC LAMINATE MATERIALS

A. Plastic Laminates: Provide high pressure plastic laminates meeting NEMA LD-3, as manufactured by Formica Corporation, by Wilsonart, by Nevamar or equal. Provide plastic laminate in general purpose grade or forming grade for special shapes. Solid color to be selected by Architect from manufacturer's standard range of color.

B. Laminates grades: General Purpose H-5 [.050”] for horizontal surfaces; VF-3 [.030”] for vertical surfaces; HF-4 [.042”] for post-forming surfaces; and .020” for backing surfaces.

C. Color core laminates: Provide through color laminates where indicated. Provide horizontal grade at horizontal surfaces and exposed verticals subject to damage such as open cubbies and exposed door edges.
1. Basis of design: Formica ColorCore 2.

D. Where stainless channel reveals or trim are required, and stainless laminate edges would show, provide solid metal units. Acceptable vendors include:
1. C.R. Laurence Co.,www.crlaurence.com/.
2. Julius Blum & Co., www.juliusblum.com/.

E. Adhesives: as recommended by laminate manufacturer. Use waterproof type at utility, food preparation, sink area, vanity and where ever laminate may come in contact with water vapor or liquid.

F. All exposed surfaces shall be covered with “face” laminate.

G. PVC edging: At the Architect’s sole discretion and approval, PVC edging may be used. Edging shall be the heaviest grade available suitable for office work applications.

2.7 SOLID SURFACE COUNTERTOPS

A. Refer to section 12 36 62.

2.8 CASEWORK HARDWARE AND ACCESSORY MATERIALS

A. General: Provide cabinet hardware and accessory materials associated with work.

C. Refer to Section 06 41 25 Hardware for architectural casework

2.9 ROUGH HARDWARE AND NAILS

A. Provide all rough hardware required to complete the work using concealed fastenings wherever possible. In general, concealed fastenings shall be bright steel, except that at exterior areas they shall be galvanized steel, non-ferrous, or stainless steel. All exposed fastenings in all locations shall be non-ferrous or stainless steel as selected or approved in each case by the Architect.

2.10 BACKPRIMING & SEALING MATERIALS

A. Work that is shop fabricated and not accessible for field priming or sealing shall be primed and/or sealed under this section.

B. Use materials compatible with final finishes and the requirements of section 09900.

2.11 SHOP FINISHES

A. Provide shop finishes for all work of this section complying with the requirements for opaque and transparent finishes specified in section 09 90 10. Work for opaque finishes is to primed. Work for transparent finishes is to be sealed only when no practical alternative to complete shop finishing is available; all other work for transparent finish is to fully finished in the shop. Touch up defects in final shop finishes under the work of this section.

B. Transparent shop finishes shall match doors. The intent of the work is that all transparent finish of casework, paneling, counters, trim, and the like match the transparent finish of the doors. Provide the coordination necessary to achieve this result.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the surfaces to receive the work of this Section before proceeding with installation. Do not proceed with installation until all unsatisfactory conditions which would impair the work have been corrected. Notify the construction manager in writing of the conditions which would impair the proper and timely completion of the work. Starting work constitutes acceptance of conditions.

3.2 PREPARATION

A. Condition work to average prevailing humidity conditions in installation areas prior to installing.

B. Deliver concrete inserts and similar anchoring devices to be built into substrates, well in advance of time substrates are to be built.

C. Prior to installation, examine shop fabricated work for completion, and complete work as required, including back priming and removal of packing.

3.3 FABRICATION

A. Finished work shall be dressed and sanded until free from machine and tool marks, abrasions, raised grain, or other defects on surfaces exposed to view. Construction and workmanship shall conform to, or exceed, the requirements of "Premium Grade" as defined in the latest edition of the AWI "Quality Standards."

B. Joints shall be tight and so formed as to conceal shrinkage. Mortise and tenon joints shall be set in glue under pressure. Shop miters four inches or greater shall be glued and doweled or locked with metal splice. Miters less than four inches shall be glued and splined with the spline concealed.

C. All exposed sides and ends of plywood shall be edged with solid strip of matching hardwood, at least 1/2 inch thick, and the full width of the plywood edge. Miter edge strips at corner.

D. All nails in finished work shall be blind nailed wherever possible and surface nails shall be set and filled with matching plastic wood.

E. Woodwork shall be properly framed, closely fitted and accurately set to the required lines and levels and shall be rigidly secured in place.

F. All finish work shall be sandpapered at field joints and where required by installation and shall be left in perfect condition for finishing.

3.4 PRIMING & SEALING

A. Seal backs and concealed portions of shop coated work.

3.5 INSTALLATION -- GENERAL

A. Install work plumb, level, true and straight with no distortions. Shim as required using concealed shims.

B. Install fabricated work to AWI 01700, meeting the requirements for the specified grade.

C. Scribe and cut work to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.

D. Secure work to anchors or blocking built-in or directly attached to substrates. Secure to grounds, strapping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where prefinished matching fasteners heads are required, use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork, and matching final finish where transparent finish is indicated.

E. Casework: Install without distortion so that panels, doors and drawers fit properly, accurately, and fully aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

3.6 ADJUSTMENT, CLEANING, FINISHING AND PROTECTION

A. Comply with Division 01 and the following:
1. Repair damaged and defective work wherever possible to eliminate defects functionally and visually; where not possible to repair properly, replace cabinets.

2. Clean hardware, lubricate and make final adjustments for proper operation.
3. Clean exposed and semi-exposed surfaces. Touch- up shop-applied finishes to restore damaged or soiled areas.
4. Repair or replace work other trades damaged or soiled by the work of this Section.
5. Protect work during remainder of construction period to ensure that work will be without damage or deterioration at time of acceptance.
6. Keep work areas clean by daily sweeping and disposal of scrap ,sawdust and debris.

END OF SECTION

SECTION 06 41 25 – HARDWARE FOR ARCHITECTURAL CASEWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 01 Specification Sections, apply to this Section.

B. Section Includes:
1. Architectural casework cabinet hardware.

C. Related Requirements:
1. Division 06 Architectural casework.
2. Division 12 Countertops.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show location of each item, large-scale details, attachment devices, and other components.
1. Show details full size.
2. Show locations and sizes of cutouts and holes.

C. Samples for Verification: Metal finishes, and if requested,
1. Exposed cabinet hardware and accessories, one unit for each type and finish.

D. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Comply with division 01 and deliver work to fabricator or site as required. Products shall be full wrapped, boxed and identified. Units shall be dust-free and except for operating mechanisms, complete free of oils.

PART 2 - PRODUCTS

2.1 CABINET HARDWARE AND ACCESSORY MATERIALS

A. General: Provide cabinet hardware and accessory materials associated with work. except for units which are specified as "door hardware" in other sections of these specifications.

B. Hardware Standards: Except as otherwise indicated, comply with ANSI A 156.9 "American National Standard for Cabinet Hardware". Quality Level: Type 2 (institutional), unless other wise indicated.

C. Where hardware is scheduled or delineated on drawings, drawing/schedule requirements shall govern. If not indicated, comply with provisions below.

D. Typical Cabinet Door & Drawer Hardware: Provide hinges, catches and pulls of types indicated, to accommodate each door size and style.

E. Casework box mounted hinges :
1. Frameless Concealed Hinges (European Type).
2. Basis of Design Product: Grass America, Inc.: Snap On 300
3. Manufacturers: Blum or Grass or Stanley.
4. Standard: BHMA A156.9, B01602.
5. Degrees of opening: Typical: 170 degrees.
6. Degrees of opening: At wall surface: 100 degrees.
7. Type: Self-closing.
8. Adjustment: Provide 3 way.

F. Butt hinges:
1. Type: Semi-concealed.
2. Basis of Design Product: TBD
3. Manufacturers: Blum or Grass or Stanley.
4. Standard for flush doors: BHMA A156.9, B01361.
5. Standard for overlay doors: BHMA A156.9, B01521.
6. Size: 2.75 ix 0.95 inch.
7. Design: 5 knuckle.
8. Material: Steel or stainless steel if typical finish is stainless.

G. Typical Hardware material and finish: BHMA 654, satin stainless finish on stainless steel base metal.

H. Cabinet Door and Drawer Pulls:
1. Back-Mounted Pulls: BHMA A156.9, B02011.
2. Basis of Design Product: As shown, if not, as follows: wire pulls.
   b. ADA compliant: Yes, required.
   c. Finish: Matte chrome.

I. Edge tab style pulls:
1. Basis of Design Product: Mockett; equals by Blum or Hafele.
   a. Model: Mockett; DP3B Series - Square Pull,
   b. Size: 4” long, 1-1/2” projection.
   c. ADA compliant: Yes, required.
   d. Finish: Typical.

J. Continuous style pulls and trim:
1. Aluminum trim: Extruded aluminum U and J channels, by Julius Blum & Co. or equal. Sizes as indicated and required, if not shown, 1 inch deep, 3 inch high.
2. Finish: As shown, if not, clear anodized aluminum.

K. Catches:
1. Basis of Design Products: Subject to review and approval.
   a. Elbow Catch: HB Ives; No. 2 x 26D. One per each inactive leaf.
   b. Magnetic Catch: HB Ives; No. 326 Mighty-Mite Heavy-Duty Magnetic Catch.
   c. Tall cabinet door latch: HB Ives No. RL30 stainless steel roller latches, mounted on top of each leaf of tall cabinet doors.
   d. Ball catches: HB Ives No. CL21A a four way catch with plate type strike with 2 spring loaded stainless steel balls, adjustable tension, strike can enter at any direction, surface or mortise, if not shown, mortise, body made of brass, finish as indicated or selected.
2. Standards:
   a. Magnetic catches, BHMA A156.9, B03141.
   b. Push-in magnetic catches, BHMA A156.9, B03131.
   c. Roller catches, BHMA A156.9, B03071.
   d. Tall cabinet roller catches: BHMA A 156, 16, E 19091.
   e. Ball friction catches, BHMA A156.9, B03013.

L. Drawer Slides: BHMA A156.9.
1. Acceptable manufacturer: Fulterer, or approved equal.
2. Standard Grade:
   a. Grade 1 /50 pound and Grade 2 / 30 pound:
   b. Mounting: Side mounted and extending under bottom edge of drawer.
   c. Extension: full-extension.
   d. Easy, soft-close feature: Required.
   e. Finish: Zinc-plated steel;.
   f. Rollers: Polymer rollers.
3. Medium duty grade: 75 pound Accuride C3800
   a. Mounting: Side mounted and extending under bottom edge of drawer];
   b. Extension: full-extension.

c. Easy, soft-close feature: Required.

4. Heavy duty grade:
   a. Grade 1HD-100 / 100 pound and Grade 1HD-200 / 200 pound:
   b. Mounting: Side mounted and extending under bottom edge of drawer];
   c. Extension: full-extension.
   d. Easy, soft-close feature: Required.
   e. Width: Intent is to have space required between drawer side and frame to be the same for 100 and 200 pound rated units.
   f. Finish & rollers: Zinc-plated-steel ball-bearing.

M. Drawer slide capacity requirements:
1. For drawers not more than 3 inches (75 mm) high and not more than 24 inches (600 mm) wide, provide: Grade 1 / 50 pound.
2. For drawers more than 3 inches (75 mm) high but not more than 6 inches (150 mm) high and not more than 24 inches (600 mm) wide, provide Grade 1HD-100 / 100 pound.
3. For drawers more than 6 inches (150 mm) high or more than 24 inches (600 mm) wide, provide: Grade 1HD-200 / 200 pound.
4. For computer keyboard shelves, provide Grade 1HD-100.
5. For trash bins not more than 20 inches (500 mm) high and 16 inches (400 mm) wide, provide: Grade 1HD-200 / 200 pound.
6. Trash can and storage bin wider than 20 inches: Extra heavy duty, 400 lb capacity.

N. Pull-Out Shelf Inserts For Blind Cabinets:
1. Basis of Design Product: Hafele Majic Corner I, for Blind Cabinets Model 446.17.9 Steel, left or right as required for conditions.

O. Cabinet pocket door assemblies [aka: Pivot sliding door runners]:
1. Manufacturer: system as manufactured by Accuride, Hafele, or approved equal.
2. Typical type: Hinged, sliding, pocketing assembly.
3. Typical model: Accuride/Hafele No. 1432 or Hafele 408.24.561 for slide length shown, if not 24 inches.
4. Color: As shown, if not, black.
5. Hardware door capacity:
   a. Height: up to 78 inch
   b. Thickness capacity: 0.75 to 1.25 inch.
   c. Weight: Up to 75 pounds.
6. Installation: For vertically mounted concealed doors.
7. Hinges: As recommended by manufacturer, generally includes 5 plus hinge carrier strip kit.

P. Adjustable Shelf Standards and Supports for cabinetry: Unless otherwise indicated, multiple shelving shall be supported with standard or pole mounted, decorative, heavy duty track standards and brackets as follows:
1. Manufacturer: Rangine Corporation, Needham, MA ; www.rakks.com.
2. Standards/wall mounted:
   a. As shown, if not, Rakks C-Standard 0.70 wide x 0.535 inch deep.
   b. Notches: Provide notches at 12 inches on center or more frequently to permit adjusting shelf brackets without disassembling other shelving.
3. Brackets: Rakks Style bracket, series as shown, if not, BR – 1.25 inch deep and BR2 2 inch deep, each 0.25 inch thick, length as required for indicated shelving.
4. Bookends: As shown, if not, Rakks Style 1.25 x 0.25 inch units.
5. Finish: As shown, if not, clear anodized
7. Comply with requirements as applicable of Section 06 45 10 Wood & composite shelving for shelving hardware intended to match stand-alone shelving assemblies.

Q. Drilled hole shelf rests: BHMA A156.9, B04013: Metal, two-pin type with shelf hold-down clip.

R. Touch latches: Glynn Johnson GJ-B

S. Door & Drawer Silencers:

1. Standards: Door and Drawer Silencers: BHMA A156.16, L03011.
2. Basis of design: Glynn Johnson GJ-65; equals by Blum or Hafele.
3. Usage: At doors and drawers to provide silent closure.

T. Locks: Comply with Owner standards, if none, as follows:
1. Cabinet locks thickness to suit material.
2. Basis of Design Product: National Manufacturing Products: Series 8050 (Disc tumbler) match typical hardware finish; if none, Satin stainless steel.
3. Keying: Cylinders for cabinet drawers and doors shall be keyed alike within each spaced and masterkeyed throughout the project, unless otherwise noted.
4. Provide locks for all cabinets drawers and doors, unless otherwise noted.
5. Standards:
   a. Door Locks: BHMA A156.11, E07121.
   b. Drawer Locks: BHMA A156.11, E07041.

U. Countertop and access accessories:
1. Metal wire access grommets: Basis-of-Design Product: Mockett; 3” Round MM5 cap and MM5A liner (2 7/8" hole), ¾” notch, Finish; based upon typical finish ; Doug Mockett & Co.
2. Flip-up power & data grommets with plug modules:
   a. Basis-of-Design Product: Mockett; PCS36A/EE series going into a 5" x 4" slot,
   b. Overall: 5 5/16" x 4 7/16".
   c. Cut Out: 5" x 4",
   d. Cord: 6 ft. electrical cord.
   e. Finish: As selected from available options.
   f. Type verification: Verify alternate units with 1 electric outlet and 1 data port or 1 electrical outlet and 2 USB charging ports are not required.
   g. Quantity: As shown on drawings.
3. Wire grommets: 2 inch diameter grommets at counter tops where outlet is behind or inside counter piece; show grommets on shop drawings. Where type not shown, provide Doug Mockett & Co. SG series in chrome.

V. Exposed hardware finishes: Comply with BHMA A156.18 for BHMA finish number indicated.
1. As scheduled, if not, provide:
   a. Satin Stainless Steel: BHMA 630.
   b. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.

W. Concealed hardware finishes: Manufacturer's standard finish complying with BHMA A156.9.

X. Slides for Sliding Glass Doors: BHMA A156.9, B07063 in material shown, if not aluminum.

2.2 FABRICATION

A. 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.

B. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop-cut openings to maximum extent possible to receive hardware, 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.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required.

3.2 INSTALLATION

A. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.

B. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

C. Cabinets: Install without distortion so doors and drawers fit openings properly 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.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

END OF SECTION

SECTION 06 49 15 – UPHOLSTERED WOOD BENCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: All Contract Documents, including Drawings, and Division 1 General Requirements apply to this Section.

B. Section includes, without limitation, providing:
1. Custom fabricated wood benches.
2. Custom fabricated cushions.

C. Related work includes, without limitation:
Section 06 16 20 – Interior Architectural Millwork.

1.2 QUALITY ASSURANCE

A. Fabric provided shall comply with applicable requirements of the following:
1. Fire Test Response Characteristics: California Technical Bulletin 133A

B. Field Dimensions:
1. Verify actual dimensions of areas to receive shop fabricated woodwork by taking field dimensions.
2. Show field dimensions on final shop drawings.
3. Build shop fabricated work to fit field conditions.

1.3 SUBMITTALS

A. Comply with Section 01 00 00, and the following:

B. Product Data: Submit manufacturer's specifications for each type of material required.

C. Samples: Show full range of color, texture, and pattern variations expected, using samples from same material to be used in the Work. Provide the following:
1. Seating fabric verification: Sample for section from full available range.
2. Seating fabric final sample: 16 inches square piece of selected fabric from dye lot to be used with specified treatments applied. Mark face and direction of application of fabric.
3. Fabricated samples: Submit full size samples of corner construction with welting, lining, and cushion foam.
4. Accessories: Provide accessory items such as zippers.

D. Quality Certification: Submit manufacturer's certification, stating that the fabricated work complies with quality grades and other requirements indicated.
1. Physical properties: Submit test results to verify compliance with fire tests, standards, grades and the like.

E. Maintenance instructions:
1. Submit manufacturer's maintenance recommendations in writing.
2. Include precautions for cleaning materials and products detrimental to finishes and performance.

F. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.4 QUALITY ASSURANCE

A. Fabric provided shall comply with applicable requirements of the following:
1. Fire Test Response Characteristics: California Technical Bulletin 133A

B. Field Dimensions:
1. Verify actual dimensions of areas to receive shop fabricated woodwork by taking field dimensions.
2. Show field dimensions on final shop drawings.
3. Build shop fabricated work to fit field conditions.

1.5 PRODUCT DELIVERY AND STORAGE

A. Comply with Division 1 and fabricator's recommendations. Ensure work is protected with stain proof coverings until acceptance.

1.6 JOB CONDITIONS

A. Do not install work until temperatures designed for final occupancy can be maintained and until site is ready to accept installation.

1.7 EXTRA MATERIALS

A. Provide up to 5% of fabrics being used in full width quantity for future re-upholstery. Include 1 complete liner and removable cushion fabric for every 10 cushions of each type; where less than 10 are provide, include one of each type.

PART 2 - PRODUCTS

2.1 BENCH CONSTRUCTION

A. Comply with requirements of Section 06 40 20 Architectural millwork and the following:
1. AWI Quality Standard: Premium grade.
2. Bench construction: As shown, if not, closed box internally framed.
   a. Exposed Wood: As shown, if not, Type 1 with transparent finish.
   b. Concealed panels: Millworker's option providing sufficient load capacity and complying with requirements.
   c. Concealed framing: Same as panels.
   d. Veneer orientation: As shown, if not shown, horizontal.
   e. Exposed edges and nosings: As shown, if not, eased, solid wood, matching adjacent wood type and finish.
   f. Fastening, joining, attachment: Concealed, glued, blocked and screwed. Do not space attachment more than 12 inches on center.
3. Shop finishes:
   a. Exposed wood: As above.
   b. Concealed: Sealed against moisture.

2.2 CUSHION FACE FABRIC & CONSTRUCTION

A. Acceptable Suppliers/Manufacturers: As indicated on drawings, if not shown, Knoll Textiles [http://www.knoll.com/] ; see: http://www.knoll.com/products/textile_category.jsp?cat_id=84. Do not order or fabricate prior to final approvals and material selection.

B. Provide products meeting the following:
1. Material: Upholstery fabric selected by architect using products costing no more than $65/yard – 54 inch roll.
2. Applied treatments: Stain resistance, flame resistance; anti-bacterial, antifungal.
3. Fluid barrier inter-liner: Required.

C. Construction:
1. Edging: As shown, if not, 0.25 inch welts.
2. Maintenance: Constructed with non-corrosive concealed zipper for removal and cleaning.

D. Usage: At Built-in sofas/benches and where shown.

2.3 ACCESSORY MATERIALS

A. Provide accessories required to complete work as required, of acceptable flame spreads and which may include:
1. Cushion: Dense latex cellular upholstery cushion not less than 4 inches thick and 2 lbs/ cubic foot.
2. Liner: Removable nylon or muslin liner with non-corrosive zipper.
3. Attachment for loose cushions in "bath tub box frame": Commercial grade Velcro fabric, spacing to resist easy removal or cushion drift.

4. Attachment for cushion over frame detail: Fabricator's standard wood rails and frames designed to drop and wedge in place to prevent movement but permit installation and removal.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the provisions of Division 01 and in particular, Section 01 70 00.

B. Install materials and systems in accordance with manufacturer's instructions, limitations and restrictions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.

C. Field measure areas and surfaces of fully completed assemblies provided by other to receive work of this Section.

3.2 BENCH FABRICATION

A. Comply with provisions of Section 06 40 20.

3.3 CUSHION FABRICATION

A. Make cushions using approved fabrics having acceptable flammability. Work shall be sized to fit existing conditions.

B. Work shall have true, straight seams; be free of wrinkles, bulges or depressions and present a neat, clean and acceptable appearance in the judgment of the Architect.

3.4 INSTALLATION

A. Install work in place and Comply with provisions of Section 06 40 20.

3.5 ADJUSTMENT, CLEANING, FINISHING AND PROTECTION

A. Repair damaged and defective work to eliminate defects functionally and visually; where not possible to repair properly, replace material.

B. Protect work during remainder of construction period to ensure that work will be without damage or deterioration at time of acceptance.

3.6 MAINTENANCE

A. Instruct owner or project representative on regular maintenance procedures required by best practice.

END OF SECTION

SECTION 06 65 00 - CELLULAR PVC TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Related documents: Drawings and general provisions of the Contract, and Division 01 Specification Sections, apply to this Section.

B. Section Includes, without limitation, providing:
1. Exterior cellular PVC plastic trim.
2. Counter sinking and plugging fasteners.
3. Kerf or routed cut treatment to create drip.

C. Extent: As shown.

D. Related Requirements:
1. Section 06 10 60 – Blocking & wood treatments.
2. Section 07 00 00 - Flashing and Sheet Metal.
3. Section 07 00 00 - Sidign.
4. Division 08 – Openings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.

B. Samples for Initial Selection: For each type of product involving selection of colors, profiles, or textures.

C. Samples for Verification:
1. For cellular PVC trim, with 1/2 of exposed surface finished; 50 sq. in. (300 sq. cm).

D. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with not less than 3 years experience.

C. Allowable Tolerances:
1. Variation in component length: -0.00 / +1.00”
2. Variation in component width: ± 1/16”
3. Variation in component thickness: ± 1/16”
4. Variation in component edge cut: ± 2?
5. Variation in Density -0% + 10%

D. Workmanship, Finish, and Appearance:
1. Free foam cellular PVC that is homogeneous and free of voids, holes, cracks, and foreign inclusions and other defects. Edges must be square, and top and bottom surfaces shall be flat with no convex or concave deviation.
2. Uniform surface free from cupping, warping, and twisting.

1.4 MOCK-UP

A. 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 and Owner.
3. Refinish mock-up area as required to produce acceptable work.

B. Mock-up may remain as part of the Work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect materials from weather by covering with impermeable, breathable, heat-reflective sheeting, securely anchored. Stack materials level and flat on a full shipping pallet with spacers between each bundle. Provide for air circulation within and around stacks and under temporary coverings.

B. Store formed or pre-fabricated pieces in the manufacturer's crates until ready for use. If necessary to remove from crates, store in crated position with duplicate supports as originally crated.

1.6 WARRANTY

A. Warranty - General: Manufacturer's warranty, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace trim that fails due to defects in manufacturing.

B. Warranty for Cellular PVC Trim: Manufacturer agrees to repair or replace trim that fails due to defects in manufacturing within specified warranty period. Failures include, but are not limited to:
1. Warranty Period: 25 years from date of Substantial Completion.
2. Failures include, without limitation: deterioration, delamination, and excessive swelling from moisture

PART 2 - PRODUCTS

2.1 EXTERIOR TRIM

A. Cellular PVC Trim: Extruded, expanded PVC with a small-cell microstructure, recommended by manufacturer for exterior use, made from UV- and heat-stabilized, rigid material.
1. Subject to compliance with specifications:
   a. Azek.
   b. Fypon Ltd.; Fypon PVC.
   c. Subject to substitution process: Approved equal products of equal performance characteristics provided deviations in size, profile, and dimensions are minor and do not alter aesthetic effect.
   d. Drawings are based upon AZEK.
2. Density: Not less than 31 lb/cu. ft. (500 kg/cu. m).
3. Heat Deflection Temperature: Not less than 130 deg F, according to ASTM D 648.
4. Coefficient of Thermal Expansion: Not more than 4.5 x 10^{-5} inches/inch x deg F.
5. Water Absorption: Not more than 1 percent, according to ASTM D 570.
6. Flame-Spread Index: 75 or less, according to ASTM E 84.

2.2 MISCELLANEOUS MATERIALS

A. Fasteners: Provide screws, in sufficient length to penetrate not less than 1-1/2 inches into wood substrate.
1. For typical sill fastening and trim fastening countersink screws and install flush cut matching plugs using the following system or approved equal:
   a. Manufacturer: OMG, Inc.; “Fastenmaster”; www.fastenmaster.com/.
   b. System: “Cortex Concealed Fastener System” designed for use with PVC from 5/8 to 5/4 inches thick.
   c. Fastener type: As recommended by manufacturer to product being used, ACQ approved, corrosion resistant fasteners
3. Provide stainless steel or hot-dip galvanized-steel fasteners, except at countersunk and plugged approved corrosion resistant coating of type recommended by manufacturer.
4. Other applications of countersunk and plugged fastener installation:
   a. Where shown.
   b. Exterior window and door surrounds, fence caps.

B. Plugs: Created using tool of type recommended by Cortex system manufacturer.

C. Adhesive for Cellular PVC Trim: Product recommended by trim manufacturer.

D. Flashing: Comply with requirements in Division 07 Section " Flashing and Sheet Metal " for flashing materials installed in exterior finish carpentry.

E. Drip: Provide saw cut or molded drip shape at sills and where shown.

F. Paint: Paint exposed trim under Division 09.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine materials before installation. Reject materials that are damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

3.3 INSTALLATION, GENERAL

A. Do not use materials that are unsound, warped, improperly treated or finished, or too small to fabricate with proper jointing arrangements.
1. Do not use manufactured units with defective surfaces, sizes, or patterns.

B. Install work level, plumb, true, and aligned with adjacent materials on solid flat, surfaces. Shim substrates as required, not trim.
1. Scribe and cut materials to fit adjoining work. Treat cuts as recommended by manufacturer.
2. Install to tolerance indicated in Part One, Quality Assurance.
3. of for level and plumb. Install adjoining exterior finish work with maximum offset for flush installation and maximum offset for reveal installation.

C. Thermal movement: Form work to allow for expansion and contraction. Comply with the following for PVC trim:
1. When properly fastened, allow for 1/8" per 18 foot.
2. Provide joints for expansion in long joints. Ensure corners do not move and working joints are provided with back-up flashing and sealants.

3.4 STANDING AND RUNNING TRIM INSTALLATION

A. Install cellular PVC trim to comply with manufacturer's written instructions.

B. Install trim with minimum number of joints practical, using full-length pieces from maximum lengths available. Do not use pieces less than 12 feet long except where necessary. Where pieces are necessary, keep “shorts” to at least 24 inches.
1. Seam / joint locations approved and located by Architect.
2. Use scarf joints for end-to-end joints.
3. Stagger end joints in adjacent and related members.
4. Use 2 fasteners per every framing member for trim boards applications. For trimboards 12” or wider and sheets, provide additional fasteners.
5. Fasteners must be installed no more than 2” from the end of each board.
6. Do not rip 3/8” and 1/2” sheet product into trim pieces. Glued to a substrate and mechanically fasten.
7. Countersunk and plugged assemblies: Comply with manufacturer recommendations, restrictions and limitations. Install fasteners perpendicular to face of trim.
8. Mitres at vertical to horizontal trim joints and vertical corners: Not permitted.

C. Adhesives:
1. Glue PVC trim to trim joints such as window surrounds, long fascia runs, etc. with recommended cellular PVC cement, to prevent joint separation.
2. Secure glue joint with fastener on each side of the joint to allow adequate bonding time.
3. Surfaces to be glued: Smooth, clean and in complete contact with each other.

D. Sealants:
1. Ensure proper sealants are used as provided under Section 07 92 00 and they comply with the following:
   a. Urethane, polyurethane or acrylic sealants without silicone.
   b. Latex sealants complying with ASTM C834, Type P.
   c. Manufacturer approved sealants, subject to confirmation at time of construction, include:
      1) Bostik Findley; Chem-Calk 600.
      2) Pecora Corporation; AC-20+.
      3) Sonneborn, Division of ChemRex Inc.; Sonolac.
      4) Tremco; Tremflex 834.

E. Fit exterior joints to exclude water. Cope at returns and miter at corners to produce tight-fitting joints with full-surface contact throughout length of joint. Plane backs of casings to provide uniform thickness across joints, where necessary for alignment.

F. Where face fastening is unavoidable, countersink fasteners and install plugs per Contex fastener system. Set plugs seamlessly and flush to surface.

3.5 ADJUSTING

A. Replace exterior finish carpentry that is damaged or does not comply with requirements. Exterior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

3.6 CLEANING

A. Clean exterior finish carpentry on exposed and semiexposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

3.7 PROTECTION

A. Protect installed products from damage from weather and other causes during construction.

B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 07 11 10 - BITUMINOUS DAMPPROOFING

PART 1 GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Provide bituminous dampproofing.
1. Extent: Where shown, and exterior steel embedded in concrete.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS

A. Dampproofing: [Do not use cut-back type except during conditions where there is a risk of frost.]
1. Manufacturers: Colbond, Inc.; or approved equal.
2. Type: Cold-applied cut-back asphalt.
   a. Standard: ASTM D 4479, Type 1, sprayed on.
3. Type: Cold-applied fibered asphalt emulsion.
   a. Standard: ASTM D 1227, Type II, Class 1, troweled on.
4. Protection Course: Compatible with dampproofing.

PART 3 EXECUTION

3.1 INSTALLATION

A. Examine substrate; report unsatisfactory conditions in writing. Beginning work means acceptance of substrate. Begin work only after substrate construction and penetrating work is complete.

B. Clean and prepare substrate; prime if recommended by dampproofing manufacturer. Protect adjacent work and surfaces from spillage, migration, and damage.

C. Comply with manufacturer's instructions and recommendations including weather and temperature limitations. Install cant strips, reinforcing strips and other accessories as recommended by dampproofing manufacturer.

D. Apply dampproofing to achieve 60 mils dry film thickness, unless greater thickness is recommended by manufacturer based on project conditions.

END OF SECTION

SECTION 07 21 02 – RIGID FOAM THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Related documents: Drawings and general provisions of the Contract, and Division 01 Specification Sections, apply to this Section.

B. Section Includes, without limitation, providing:
1. Foam-plastic board insulation.

C. Related Sections:
1. Division 07 – Other thermal insulations.
2. Section 07 21 03 – Batt & Blanket Thermal Insulation.
3. Section 07 21 15 – Cavity wall insulation.
4. Section 07 21 30 – Foam gap insulation.
5. Section 07 26 10 – Vapor retarders.
6. Section 07 84 00 – Fire and smoke stopping insulation.
7. Division 07 - Membrane roofing insulation.
8. Section 07 84 46 - Fire-Resistive joint for insulation.
9. Section 09 81 10 – Acoustical insulation & accessories.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:
1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 FOAM-PLASTIC BOARD INSULATION

A. Extruded-Polystyrene Board Insulation (XPS): ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. DiversiFoam Products.
   b. Dow Chemical Company (The).
   c. Owens Corning.
   d. Pactiv Building Products.
   e. Approved equal.

2. Configuration:
   a. Thickness: As shown, not less than R 5.0 per inch or better.
   b. Edge: Lap or square, as shown, if not shown, square.
3. Type IV, 25 psi (173 kPa). Typical, including, as applicable, vertical and interior slabs with normal loading.

2.2 POLYISOCYANURATE FOAM-PLASTIC BOARD

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Dow Chemical Company (The). (Thermax)
   2. Firestone Building Products, Firestone Building Products; Enverge CI Foil Exterior Wall Insulation
   3. Johns Manville, (AP Foil-faced Foam Sheathing).
   4. Rmax, Inc. (Thermasheath-3)

B. Configuration:
   1. Thickness: As shown, not less than R 6.0 per inch.
   2. Edge: Lap or square, as shown, if not shown, square.

C. Material characteristics:
   1. Composition: Foil-Faced, Polyisocyanurate Board Insulation: ASTM C1289, Type I, Class 1 or 2, Grade 3 or better.
   2. Maximum flame-spread and smoke-developed indexes: $\leq$ 25 and $\leq$ 450, respectively, per ASTM E84.
   3. Minimum Compressive Strength $\geq$25 psi when tested per ASTM D1621
   4. Minimum Tensile Strength $\geq$1000 when tested per ASTM C209
   5. Minimum Flexural Strength $\geq$40 psi when tested per ASTM C203
   6. Water Vapor Transmission $\leq$0.03 perms per inch when tested per ASTM E96
   7. Water Absorption Maximum $\leq$1% by volume when tested per ASTM C209
   8. Dimensional Stability, Maximum $\leq$0.05% length and width, and $\leq$3.5% thickness when tested per ASTM D2126.
   9. Blowing agent: CFC-, HCFC- and HFC-free with zero Ozone Depletion Potential (ODP)

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

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. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

E. Other cavity and penetration preparation requirements:
   1. Air seal all penetrations through the ceiling including plumbing, wiring, seams between top plate and drywall and all other gaps or holes, with the appropriate air sealing materials or insulation itself.

3.3 INSTALLATION OF BELOW-GRADE INSULATION

A. On vertical surfaces, set insulation units according to manufacturer's written instructions.
   1. If not otherwise indicated, extend insulation a minimum of 24 inches (610 mm) 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 a minimum of 24 inches (610 mm) in from exterior walls.
   2. For slabs on grade of habitable spaces, or educational spaces, extend insulation under entire slab.

3.4 INSTALLATION OF INSULATION FOR FRAMED & WALL CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation.

3.5 PROTECTION

A. Protect installed insulation[and vapor retarders] from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 07 21 03 – BATT & BLANKET THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Related documents: Drawings and general provisions of the Contract, and Division 01 Specification Sections, apply to this Section.

B. Section Includes, without limitation, providing:
1. Glass-fiber blanket insulation.
2. Mineral-wool insulation.

C. Related Sections:
1. Division 07 – Other thermal insulations.
2. Section 07 21 02 – Rigid Foam Thermal Insulation.
3. Section 07 21 30 – Foam gap insulation.
4. Section 07 26 10 – Vapor retarders.
5. Division 07 - Membrane roofing insulation.
6. Section 09 81 10 – Acoustical insulation & accessories.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

C. Research/Evaluation Reports: For foam-plastic insulation, from [CC-ES.

D. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.1 GLASS-FIBER BLANKET & BATT INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CertainTeed Corporation.
2. Guardian Building Products, Inc.
3. Johns Manville.
4. Knauf Insulation.
5. Owens Corning.
6. Approved equal.

B. Standards: Comply with the following for types of insulation indicated.
1. ASTM C 665; Type I, Class A (unfaced)
2. ASTM C 665; Type II, Class C (kraft faced)
3. ASTM C 665; Type III, Class A (FSK-25 foil faced)

4. ASTM C 665; Type III, Class B (foil faced)

C. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

D. High density glass fiber insulation:
1. Manufacturers: subject to compliance with specifications, provide one of the following:
   a. Eco-Touch, Owens Corning.
   b. EcoBatt-Knauf.
   c. High Performance Fiber Glass Building Insulation-CertainTeed.
   d. Approved equal.
   e. Note: Certain manufacturers label these products: “HD”; use those to meet performance.
2. Standards: Meet or exceed the following:
   a. Unfaced insulation: ASTM C665, Type I, Class A.
   b. Kraft-faced insulation: ASTM C665, Type II, Class C.
3. Usage: Where shown, including between exterior wall studs and in “cathedral ceilings.
4. R values: As shown.
5. Thickness: to meet indicated R values.
6. Performance: Insulation capable of meeting the following:
   a. Wall applications: R=13 in 3.5 inches minimum.
   b. Wall applications: R=20 in 5.5 inches minimum.
   c. Cathedral ceiling applications: R=38 in 10.25 inches.
7. Facing: As indicated if not, unfaced.

E. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:
1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

2.2 MINERAL-WOOL INSULATION

A. Provide one or both of the following mineral wool insulation, per indications on drawings.
1. Where “batt” mineral wool. insulation is indicated, provide semi-rigid batts.
2. Where “rigid” or “board” mineral wool insulation is indicated, provide mineral board insulation.

2.3 MINERAL-WOOL BOARD INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Fibrex Insulations Inc.
2. Isolatek International.
3. Owens Corning.
4. Roxul Inc.
5. Thermafiber.
6. Approved equal.

B. Unfaced, Mineral-Wool Board Insulation: ASTM C 612; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
1. Nominal density of 4 lb/cu. ft. (64 kg/cu. m), Types IA and IB, thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F (27.7 K x m/W at 24 deg C).
4. Fiber Color: Darkened, where indicated.

2.4 MINERAL-WOOL SEMI-RIGID BATT INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Fibrex Insulations Inc.
2. Owens Corning.
3. Roxul Inc.
4. Rockwool
5. Thermafiber.

6. Approved equal.

B. Basis of design: Rockwool ComfortBatt.

C. Unfaced, Mineral-Wool Semi-rigid Insulation made from basalt rock and slag : Comply with the following criteria:
1. Standard: ASTM C 665; Type I.
2. Flame-spread: 0 per ASTM E84.
3. Smoke developed: 0 per ASTM E84.
4. Density: 2 pounds per cubic foot, minimum, per ASTM C 167.
5. Combustion: Rated non-combustible per NFPA 220.
6. R value: 15 per 3.5 inch of thickness per ASTM C518.
8. Corrosion: Non-corrosive per ASTM C665.
9. Permeability: 50 perms per ASTM E96.
10. Width: to fit assemblies indicated.

2.5 MINERAL-WOOL BLANKET INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Fibrex Insulations Inc.
2. Owens Corning.
3. Roxul Inc.
4. Thermafiber.
5. Approved equal.

B. Unfaced, Mineral-Wool Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

2.6 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.
1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
a. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
b. Gemco; Spindle Type.
2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation indicated.

B. Adhesively Attached, Angle-Shaped, Spindle-Type Anchors: Angle welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Gemco; 90-Degree Insulation Hangers.
2. Angle: Formed from 0.030-inch- (0.762-mm-) thick, perforated, galvanized carbon-steel sheet with each leg 2 inches (50 mm) square.
3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation indicated.

C. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.
1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
a. AGM Industries, Inc.; [RC150] [SC150].
b. Gemco; [Dome-Cap] [R-150] [S-150].
2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
a. Crawl spaces.

b. Ceiling plenums.
c. Attic spaces.
d. Where indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

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. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

E. Other cavity and penetration preparation requirements:
1. Air seal all penetrations through the ceiling including plumbing, wiring, seams between top plate and drywall and all other gaps or holes, with the appropriate air sealing materials or insulation itself.

3.3 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Glass-Fiber or Mineral-Wool 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 (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
5. For wood-framed construction, install blankets according to ASTM C 1320 and as follows:
a. With faced blankets having stapling flanges, secure insulation by inset, stapling flanges to sides of framing members.

C. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
1. Loose-Fill Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft. (40 kg/cu. m).

3.4 SPINDLE ANCHOR INSTALLATION

A. Install as recommended by manufacturer, if not, as follows:
1. Secure spindle with general purpose liquid adhesive applied to a clean, dust free surface.
2. Apply spindle to a cleaned, dry, smooth surface. Remove any oil, rust, loose paint dust or the like before applying fastener
3. Apply sufficient adhesive to base of fastener.

4. Firmly press fastener against cleaned surface and slightly twist the fastener to force adhesive through base plate holes.
5. Impale insulation over point of fastener.
6. Secure insulation with a self locking washer.
7. Bend or remove remaining point.

3.5 PROTECTION

A. Protect installed insulation and accessory or adjacent assemblies from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 07 21 30 - FOAM GAP INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Foamed-in-place gap insulation.
2. Sill sealers.

C. Extent: Where shown and:
1. Fill all gaps in building thermal envelope not addressed by the sections and including:
2. Envelope joints, seams, and penetrations.
3. Openings or gaps between door and window assemblies.
4. Utility penetrations.
5. Rim and band joist junctions.
6. Spaces behind tubs and showers on exterior walls.
7. At penetrations and holes in thermal envelope.

1.2 REFERENCED CODES AND STANDARDS

A. All references to codes, specifications and standards referred to herein shall become a part of this section as though written out, and shall mean, and is intended to be the latest edition, amendment, and/or revision of such reference unless otherwise specified.
ASTM - American Standards for Testing and Materials.
NRCA - National Roofing Contractors Association.

1.3 SUBMITTALS

A. Submittals: Conform to requirements of Division 1 and submit:

B. Manufacturer's Data Sheets: Provide data on product characteristics, performance criteria limitations and insulation values.

C. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.4 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to project site in manufacturer's original packaging. Clearly identify manufacturer, contents, brand name, applicable standard, and R-value.

B. Store materials off ground. Protect against weather, condensation, and damage; immediately remove damaged material from site.

1.5 SEQUENCING/SCHEDULING

A. Coordinate and cooperate for installation of each type insulation specified with respective trades, particularly work specified under Section 09255, whose work is affected in order to complete the work specified herein.

1.6 DESIGN REQUIREMENTS

A. Materials properties or classes shall meet or be determined by the following ASTM standards:
1. ASTM C-518: Thermal Resistance (R) values.
2. ASTM E-96: Permeance of facing and/or insulating material

PART 2 - PRODUCTS

2.1 SPRAY FOAM GAP INSULATION

A. Manufacturers:
1. Basis of design: Todol Products, Pur Fill IG.
2. Dow Chemical.
3. Hilti.
4. Approved equal.

B. Material: Sprayed-in-place expanding urethane foam with the following characteristics:
1. Materials: One-component, water-cure closed cell polyurethane containing no urea-formaldehyde and no CFCs ; maximum 100% expansion.
2. Thermal Performance: Approximately R6 per inch.
3. Burn Characteristics: ASTM E 84, flame spread less than 25, smoke development less than 210, fuel contribution 0.
4. Water Absorption: Hydrophobic.
5. Closed-Cell Formulation: 80% per ASTM D 2856.
6. Expansion rate: As recommended by manufacturer for application:

2.2 FOUNDATION SILL SEALER

A. Provide resilient foam sill sealer between bottom to sill plates and top of bearing surfaces. Sill sealers shall not be less than 0.50 inches less wide than sill plate.

B. Acceptable air leakage prevention products include:
1. WEATHERMATE™ SILL SEAL a flexible polyurethane foam gasket, by Dow Chemical.
2. Reflectix Sill Sealer by Reflctix Inc, a ribbed polyethylene foam gasket.
3. GreenGuard Sill Sealer by GreenGuard, a ribbed polyethylene foam gasket.

2.3 VAPOR RETARDERS

A. Refer to Section 07 26 10 or applicable sections with integral vapor barriers.

PART 3 - EXECUTION

3.1 ACCEPTANCE OF SURFACES

A. Starting work under the section shall be construed as accepting of all surfaces as being satisfactory, and any defects in this work resulting from the accepted surface shall be corrected by this applicator without additional cost to the Owner.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. Foam Gap Testing: Test installation to verify and ensure frames of doors and windows and the like remain plumb, plane and true, free of warp, bow or twisting or misalignment.

C. Do not use foams which exert undue or excessive pressure on assemblies.

D. Spray-Applied Foam Gap Insulation
1. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked.
2. After insulation is applied, make flush with face of studs or framing elements by using method recommended by foam gap insulation manufacturer.
3. Ensure foam insulation is exposed to atmospheric moisture to ensure cure.
4. Fill gaps and joints in several layers by application of small foam strings no deeper than 2 inches.
5. Apply foam in continuous bead without voids or breaks. Do not overfill gaps and allow foam to expand.

E. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation.

F. Install sill sealers continuously under sill stud plates.

G. Install insulating sealants to complete installation and provide a continuous, seamless thermal barrier.

H. Where assemblies have been displaced, warped, bowed or otherwise degraded, remove foam and ensure assemblies return to proper alignment. Replace all work which is not in proper, acceptable condition.

3.3 CLEAN-UP

A. This installer shall remove all equipment, materials and debris from the work and storage areas and leave those areas in clean, undamaged and acceptable condition.

END OF SECTION

SECTION 07 21 32 - SPRAYED FOAM URETHANE INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section Includes, without limitation, providing:
1. Sprayed, medium density, closed cell, polyurethane foam insulation.
2. Support mesh for thick installations.
3. Applied flame barrier at exposed applications.

C. Extent, without limitation, includes:
1. Where shown.

D. Related requirements includes, without limitation:
1. Section 07 20 00 - Thermal insulation.
2. Section 07 21 30 - Foam gap insulation.

1.2 REFERENCES

A. Comply with indicated references and the following:
1. ASTM C 518: Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
2. ASTM D 2863: Standard Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)
3. ASTM E 84: Test Method for Surface Burning Characteristics of Building Materials
4. ASTM E 96: Standard Test Methods for Water Vapor Transmission of Materials
5. ASTM E 2178: Standard Test Method for Air Permeance of Building Materials
6. ASTM E 283: Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

1.3 SUBMITTALS

A. Comply with Division 01 General Requirements and submit for approval:
1. Product Data: Manufacturer's literature including installation instructions, use restrictions and limitations.

B. Mock-Up/Field Samples: Prior to installation, provide mock up of each type of system proposed for use for approval. Accepted mock-ups may be incorporated into the work unless otherwise noted.

C. Product Test Reports: Submit manufacturer's certified independent lab test reports not more than 2 years old documenting product performance.

D. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.4 QUALITY ASSURANCE

A. Single Source Responsibility: Provide products from one manufacturer.

B. Installer Qualifications: Engage an licensed dealer (applicator) who has been trained and certified by foam manufacturer.

C. Fire-Test-Response Characteristics:
1. Surface-Burning Characteristics: Provide products tested per ASTM E 84 and complying with specifications and authorities having jurisdiction.
2. Labeling: Identify materials with appropriate markings of applicable testing and inspecting agency.

D. Toxicity/Hazardous Materials - Provide products that:
1. Contain no urea-formaldehyde

2. Requiring or use no CFCs, HCFCs, or HFCs during manufacture or application.
3. Contain no PBDEs
4. Are “Low-emitting”.

E. Preconstruction conference: Review extent of work, types of insulation to be used, work by other trades or applicators as well as special applications and prevention of overspray.

1.5 PRODUCT REQUIREMENTS

A. Comply with product requirements, delivery storage and handling provisions of Division01 and the following:
1. Do not deliver panels until job is ready for installation.
2. Store products in ventilated dry area; protect from dampness, freezing, and direct sun light.
3. Maintain temperatures below 100 °F and above 50 °F.

1.6 PROJECT CONDITIONS

A. Prevent products before, during or after installation from being exposed to UV radiation.

1.7 WARRANTY

A. Provide manufacturer's standard limited life time warranty.

1.8 MAINTENANCE

A. Provide instruction, maintenance and inspection recommendations for ensuring products longevity.

1.9 OWNER’S INSPECTION AND TESTING

A. Cooperate with Owner’s testing agency. Allow access to work areas and staging. Notify Owner’s testing agency in writing of schedule for Work of this Section to allow sufficient time for testing and inspection. Do not cover Work of this Section until testing and inspection is accepted.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Acceptable manufacturers and fabricators include:
1. Polyurethane Spray Foam Insulation: by Icynene Inc www.Icynene.com.
2. CertaSpray Closed Cell Foram by CertainTeed, a division of Saint-Gobain; www.certainteed.com/insulation/.
3. “Styrofoam Polyurethane Foam Insulation” by Dow; RS Series.
4. “HeatLok Soy-200 ” by Demilec.
5. WallTitte US” by BASF

2.2 MINIMUM PERFORMANCE RATINGS

A. All other indications notwithstanding, products of this section shall meet the following criteria:
1. Global Warming Potential: GWP of 1 or better.
2. Aged Thermal Resistance: 6.2 per inch*
3. Core Density: 2.0 lb.
4. Greenguard Gold certified
5. Class II vapor retarder at 1.4” thickness
6. Meets FEMA criteria for resisting water absorption
7.

2.3 CLOSED CELL POLYURETHANE INSULATION

A. Characteristics: Medium density, closed celled, semi-rigid, polyurethane foam insulation.

B. Basis of Design: ICYNENE ProSeal HFO

C. Materials: Meet or exceed the following:
1. Thermal Resistance (R-Value/inch @75 deg F): ASTM C 518; 6.7 hr/sq ft/degree F/BTU and equal to R6.2 at 1 inch.
2. Thermal Resistance (for 3.5 inch of material) (R-Value/inch @75 deg F): ASTM C 518; 24 hr.sq ft.degree F/BTU

3. Heat Flow Reduction:
   a. Through 1 inch: 75 percent
   b. Through 3.5 inches 93 percent
   c. Through 5.5 inches 95 percent
   d. Through 10.5 inches 98 percent
4. Air Permeance (for 1 inch of material): ASTM E 2178; <0.02 L/S.m^2 @75 Pa
5. Water Vapor Transmission (for 1.4 inches of material) Per ASTM E 96, 0.90 perms and equal to a Class II vapor retarder.
6. Flame Spread and Smoke Developed Rating: ASTM E 84
   a. Flame Spread: Less than 15
   b. Smoke Development: Less than 350
7. Low emitting per CA 01350 Criteria.
8. Vapor permeable: No.
9. Blowing agent: HFO type based on hydrofluoroolefin (HFO) chemistry with a Global Warming Potential of 1 or better. Lower numbers are better.
10. Resistance to Fungal Growth: ASTM C 1338: no growth

2.4 TRANSITION MEMBRANES

A. Transition Membrane Between Air Barrier Membrane and Roofing and Other Adjacent Materials: Comply with both air barrier manufacturer's recommendations and material manufacturer's recommendations

2.5 FIRE & FLAME RESISTANCE

A. Provide where shown or required for exposed assemblies not protected by other fire resistant membrane assembly such as gypsum board, provide International Fireproof Technology Inc. DC-315 or Noburn Plus ThB by No-Burn: water-based, intumescent paint, conforming to the following
   1. Full scale fire resistance test with Icynene ProSeal (MD-C-200v3) in accordance with NFPA 286: 24 wet mils (thermal barrier).
   2. Finish: flat, grey color
   3. VOC Content: 47 g/L
   4. olume Solids: 67%
   5. Flash Point: none
   6. Mechanism of cure: coalescence
   7. Reducer/cleaner: water
   8. Collaborative for High Performance Schools (CHPS) "Low-emitting" material per CA Section 01350 criteria.
   9. Installation, not less than:
      a. Thermal Barrier coating: 14 mills wet.
      b. No-Burn Plus ThB Thermal Barrier coating: 18 mils wet.

2.6 ACCESSORIES

A. Provide manufacturers recommended products at exposed, or unsupported insulation as follows:
   1. Thick insulation applications: Provide supporting mesh where manufacturer recommends same or at 6 inches, whichever is less. Type as recommended by manufacturer.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the provisions of Section 01 70 00 - including requirements related to:
   1. Inspection and examination.
   2. Approvals, inspections and filed quality control.
   3. Cleaning.
   4. Protection.

3.2 EXAMINATION

A. Verify extent of usage with Architect for types of insulation specified.

B. Examine and verify conditions per Section 01 70 00 and as follows:

1. Verify substrates and underlying work is suitable for system application.
2. Verify structural components are properly placed and fully installed.
3. Before installation, examine rough-in and built-in construction for mechanical/electrical and other systems to verify actual locations of connections.
4. Proceed with installation only after unsatisfactory conditions have been corrected.

C. Review placement area to determine final location will not be within 3 inches of any heat source where the temperature will exceed 180 deg F per ASTM C 411
   1. Or comply with authorities having jurisdiction for more stringent requirements.

D. Clean substrates and cavities of loose materials capable of interfering with insulation placement.

3.3 PREPARATION

A. Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.
   1. Ensure that penetrating work by other trades is in place and complete.
   2. Prepare surfaces by brushing, scrubbing, scraping, grinding or compressed air to remove loose mortar, dust, oil, grease, oxidation, mill scale and other contaminants which will affect adhesion of the spray polyurethane foam.
   3. Wipe down metal surfaces to remove release agents or other non-compatible coatings, using clean sponges or rags soaked in a solvent compatible with the spray polyurethane foam.

B. Prime substrate for installation of sheet membrane transition strips as recommended by manufacturer and as follows:
   1. Prime masonry, concrete substrates with conditioning primers.
   2. Prime glass-fiber surfaced gypsum sheathing an adequate number of coats to achieve required bond, with adequate drying time between coats.
   3. Prime wood, metal, and painted substrates with primer.
   4. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through air barrier and at protrusions.

C. Protection from Spray Applied Materials:
   1. Mask and cover adjacent areas to protect from over spray.
   2. Ensure any required foam stop or back up material are in place to prevent over spray and achieve complete seal.
   3. Seal off existing ventilation equipment. Install temporary ducting and fans to ensure exhaust fumes. Provide for make-up air.
   4. Erect barriers, isolate area and post warning signs to advise non-protected personnel to avoid the spray area.

3.4 APPLICATION

A. Apply foam neatly, thoroughly and according to direction and recommendations of manufacturer and as follows:
   1. Site mix liquid components.
   2. Follow manufacturer's written instructions.
   3. Apply insulation to produce thickness required for indicated R Value [These vary depending upon selected product].
      a. Medium density foam only: R achieved at 3 1/2 inches ranges from 20.3 to 23.1.
      b. Medium density foam only: R achieved at 5 1/2 inches ranges from 31.9 to 36.3.
   4. Extend insulation in thickness indicated to envelop entire area to be insulated.

B. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

C. Other open cavity and penetration preparation requirements:
   1. Air seal all penetrations through the ceiling including plumbing, wiring, seams between top plate and drywall and all other gaps or holes, with the appropriate air sealing materials or insulation itself.

3.5 TRANSITION STRIP MEMBRANE INSTALLATION

A. Install transition strip materials to provide continuity throughout the building envelope. Install materials in accordance with manufacturer's recommendations and the following:
1. Apply primer for transition strips at rate recommended by manufacturer. Allow primer to dry completely before transition strip application. Apply as many coats as necessary for proper adhesion.
2. Position subsequent sheets of transition strips applied above so that membrane overlaps the membrane sheet below by a minimum of 50 mm, unless greater overlap is recommended by manufacturer. Roll into place with roller.
3. Overlap horizontally adjacent pieces of transition strips a minimum of 50 mm, unless greater overlap is recommended by manufacturer. Roll seams with roller.
4. Seal around all penetrations with a transition strip or other procedure in accordance with manufacturer's recommendations.
5. At changes in substrate plane, provide transition material recommended by manufacturer to make a smooth transition from one plane to another.
6. Provide mechanically fastened non-corrosive metal sheet to span gaps in substrate plane and to make a smooth transition from one plane to the other. Membrane shall be continuously supported by substrate.
7. At through-wall flashings, provide an additional 6 inch wide strip of manufacturer's recommended membrane counterflashing to seal top of through-wall flashing to membrane. Seal exposed top edge of strip with bead of mastic as recommended by manufacturer.
8. At deflection and control joints, provide backup for the membrane to accommodate anticipated movement.
9. At expansion and seismic joints provide transition to the joint assemblies.
10. Apply a bead or trowel coat of mastic along membrane seams at reverse lapped seams, rough cuts, and as recommended by the manufacturer when membrane will be exposed to the elements.
11. Inspect installation prior to enclosing assembly and repair damaged areas with spray polyurethane foam as recommended by manufacturer.

3.6 CLEANING / PROTECTION

A. Comply with Section 01 70 00 and the following:
1. Cleaning: Remove loose debris, overspray, and protective wraps.
2. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse.

END OF SECTION

SECTION 07 26 10 – VAPOR RETARDERS

PART 1 - GENERAL

1.1 SUMMARY

A. Related documents: Drawings and general provisions of the Contract, and Division 01 Specification Sections, apply to this Section.

B. Section Includes, without limitation, providing:
1. Vapor retarders membranes.
2. Accessories and system components.

1.2 SUBMITTALS

A. Product Data: Manufacturer's literature including installation instructions, use restrictions and limitations.

B. Mock-Up/Field Samples: Prior to installation, provide mock up of each type of system proposed for use for approval. Accepted mock-ups may be incorporated into the work unless otherwise noted.

C. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Comply with Division 01.

PART 2 - PRODUCTS

2.1 FABRICATOR / MANUFACTURER

A. Acceptable manufacturers and fabricators include: As indicated below.

2.2 USAGE

A. As indicated; if not shown, as given below:

B. At walls and ceilings: At interior side of exterior walls and ceilings unless indicated to the contrary, provide vapor barriers in full wall length and width pieces, without joints wherever possible.
1. Not required at assemblies with integral vapor retarders or which a functional vapor retarders such as insulated gasketed metal panels.

C. At slabs-on-grade: Below slabs, provide vapor barriers in full length and width pieces, with fewest joints possible. Furnish and install under Section 07 26 11 where included in project manual.

H. Vapor barrier – Provide where shown; where not shown provide at warm side of exterior walls and ceilings having unfaced fiber batts or fiber spray and equal to the following:
1. Usage: As above.
2. Material: 2 mil nylon Polyamide "adjustable perm" vapor retarder.
3. Product: "MemBrain" by CertainTeed or approved equal.

2.3 ACCESSORIES

A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

B. Vapor retarder (barrier) device box cover:
1. Provide pre-fabricated units at electrical, mechanical or low voltage boxes and devices or assemblies which will adversely affect or interfere with vapor retarder continuity. Acceptable products include:
a. Lessco Air-Vapor Barrier Box; see www.lessco-airtight.com/.

PART 3 - EXECUTION

3.1 PREPARATION

A. Comply with requirements of Division 01 and 01 70 00.

B. Clean substrates of substances that are harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION

A. Strictly comply with retarder manufacturer's printed instructions, approved submittals and the following:
1. Apply materials within manufacturer's requirements for temperature and weather conditions.
2. Do not apply to wet or frozen substrates.
3. Do not allow contamination with dust or dirt.
4. Extend vapor retarder to extremities of areas to be protected from vapor transmission.
5. Secure in place with adhesives or other anchorage.
6. Locate seams at framing members, overlap, and seal with tape.
7. Seal completely at edges, perimeter and penetrations.

END OF SECTION

SECTION 07 26 11 - UNDER SLAB VAPOR RETARDER

PART 1 - GENERAL

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Vapor retarders under slabs-on-grade.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:
1. Section 03 30 00 - Cast-In-Place Concrete.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Protect materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

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, the following:
1. Grace Construction Products.
2. Raven Industries Inc.
3. Stego Industries, LLC.

2.2 VAPOR BARRIER

A. Vapor Barrier shall have the following qualities:
1. Permeance of less than 0.01 perms per ASTM F 1249 or ASTM E 96.
2. ASTM E 1745 Class A.
3. Thickness: As shown, if not, 15 mil if.
4. Material: Multi-layer plastic extrusion of high grade prime, virgin, polyolefin resin.
5. Basis-of-Design: Stego Wrap Vapor Barrier by Stego Industries LLC.

B. Accessories:
1. Seam Tape:
   a. Permeance less than 0.3 perms per ASTM F 1249 or ASTM E 96.
   b. Basis-of-Design: Stego Tape by Stego Industries LLC.
2. Vapor Proofing Mastic:
   a. Permeance less than 0.3 perms per ASTM F 1249 or ASTM E 96.
   b. Basis-of-Design: Stego Mastic by Stego Industries LLC.
3. Pipe Boots: Construct pipe boots from vapor barrier material, pressure sensitive tape and/or mastic per manufacturer’s instructions.
4. Perimeter/edge seal: Manufacturer standard components, including:
   a. Stego Crete Claw
   b. Stego Term Bar

c. StegoTack Tape (double-sided sealant tape)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances harmful to vapor retarders, including removing projections capable of puncturing vapor retarders.

3.3 INSTALLATION

A. Install vapor retarder membrane in accordance with ASTM E1643 and manufacturer's instructions.

B. Unroll vapor retarder membrane with longest dimension parallel to direction of slabs-on-grade concrete pour.

C. Lap vapor retarder membrane over footings and seal to foundation walls in accordance with manufacturer's recommendations.

D. Lap vapor retarder membrane joints a minimum of 6 inches and seal with seam tape.

E. Seal vapor retarder membrane penetrations by applying penetration seal or by constructing boots from vapor retarder membrane and seam tape, and as follows:
1. For interior forming applications, avoid use of non-permanent stakes driven through vapor retarder. Use blunt-end and/or threaded nail stakes (screed pad posts) and insert into manufacturer recommended component. Ensure peel-and-stick adhesive base is fully adhered to vapor retarder.
2. If non-permanent stakes are driven through vapor retarder, repair as recommended by vapor retarder manufacturer.
3. Use reinforcing bar supports with base sections to eliminate or minimize potential for puncture of vapor retarder.

F. Repair damaged areas by cutting patches of vapor retarder membrane, extending 6 inches, minimum, beyond damaged area. Seal patch perimeter with seam tape.

3.4 PROTECTION

A. Protect installed vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes.

END OF SECTION

SECTION 07 31 10 - ASPHALT SHINGLES

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Asphalt shingles.
2. Underlayments.
3. Ridge vents.
4. Accessories.
5. Coordination with work of other trades.

C. Related work without limitation includes:
1. Division 06 – Carpentry.
2. Section 07 72 10 - Snow Guards.
3. Section 07 71 23 – Manufactured Gutters & Downspouts.
4. Division 07 – Roofing assemblies.

1.2 SUBMITTALS

A. Comply with Division 01 General Requirements and submit for approval:
1. Product Data: Manufacturer's literature including installation instructions, use restrictions and limitations.
2. Initial Selection samples: Provide samples of color and material ranges.
3. Maintenance Data: Provide recommended maintenance procedures.
4. Certification: Certify submitted materials comply with requirements.
5. Attic stock: Per Section 01 78 00.

B. Quality Assurance submittals:
1. Mock-Up/Field Samples: Prior to installation, provide mock up of each type of system proposed for use for approval. Accepted mock-ups may be incorporated into the work unless otherwise noted.
2. Product test reports.
3. Research/evaluation reports.
4. Warranties: Sample of special warranties.
5. Maintenance data.

C. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Fire-Resistance Characteristics: Where indicated, provide asphalt shingles and related roofing materials identical to those of assemblies tested for fire resistance per test method below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.
1. Exterior Fire-Test Exposure: Class ,A ASTM E 108 or UL 790, for application and roof slopes indicated.

B. Preinstallation Conference: Required.

1.4 WARRANTY

A. Special Warranty: Standard form in which manufacturer agrees to repair or replace asphalt shingles that fail in materials or workmanship within specified warranty period, starting at Substantial completion.
1. 15-year 60 mph wind-resistance warranty. Where upgrades are available, advise Owner of cost in writing attached to bid or proposals.

2. Material Warranty Period: **40** years, prorated, transferable, with first 30 years nonprorated.
3. Algae-Discoloration Warranty Period: Asphalt shingles will not discolor 15 years from date of Substantial Completion.

1.5 EXTRA MATERIALS

A. Comply with Section 01 78 00.1.

1.6 MAINTENANCE CONTRACT

A. As part of base bid, provide a 2 year maintenance contract as part of base bid, to include field work to check and to seal all tabs at end of first year after date of substantial completion.

PART 2 - PRODUCTS

2.1 GLASS-FIBER-REINFORCED ASPHALT SHINGLES

A. Laminated-Strip Asphalt Shingles: Laminated, 3 tab, glass-fiber reinforced, mineral-granule surfaced, and self-sealing.
1. Subject to compliance with requirements, provide or comparable product by one of the following:
   a. Owens Corning Corporation.
   b. CertainTeed Corporation.
   c. Elk Premium Building Products, Inc.; an ElkCorp company.
   d. GAF Materials Corporation.
2. Basis of design: GAF Timberline" series.

B. Components and characteristics:
1. Mineral-surfaced, self-sealing, laminated multi-ply overlay construction fiberglass based strip shingle
2. Weight: Manufacturer standard for specified shingle in lbs. per square
3. Standards: Meet and provide the following standards and performance:
   a. UL Class A fire resistance – UL 790
   b. UL Wind resistance – UL 997.
   c. UL certified to meet ASTM D3462
   d. UL certified to meet ASTM 3018 Type I
   e. UL 2218 Class 2 impact resistance rating
   f. ASTM D3161, Type 1 Class F, wind resistance
   g. Conforms to CSA standard A123.5
   h. UL External fire exposure label.
   i. UL "Wind Resistant" label
4. Strip Size: Manufacturer's standard, not less than 36 inches.
5. Algae Resistance: Granules treated to resist algae discoloration.
6. Color and Blends: As selected by Architect from manufacturer's full range.

C. Hip and Ridge Shingles: Manufacturer's standard units to match asphalt shingles .

D. Starter strip: Manufacturer standard.

2.2 UNDERLAYMENT MATERIALS

A. Self-Adhering Sheet Underlayment, High Temperature: Minimum of 30- to 40-mil- (0.76- to 1.0-mm-) thick, slip-resisting, polyethylene-film-reinforced top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release paper backing; cold applied. Provide primer for adjoining concrete or masonry surfaces to receive underlayment.
1. Thermal Stability: Stable after testing at 240 deg F (116 deg C); ASTM D 1970.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.
3. Note: Whether or not shown on drawings, cover entire roof areas, at slopes of 4 in 12 and less.
4. Granular surface: Provide for slopes in excess of 6 in 12.
5. Acceptable products include:

a. Grace Vycor; Grace Construction Products.
b. CCW WPI 200; Carlisle Coatings & Waterproofing.
c. Eaveguard Shingle Underlayment; The Henry Company

C. Felt: If shown, provide ASTM D 226 or ASTM D 4869, Type I Type II, asphalt-saturated organic felts, nonperforated.

D. Underlayment where SBS leak barrier / ice and water shield type is not required nor indicated:
1. Premium, water repellant, breather type non-asphaltic underlayment. UV stabilized polymer construction. Meets or exceeds ASTM D226 and D4869. Approved by Dade Country, Florida Building Code, and ICC; GAF Available products include:
a. GAF Deck-Armor.
b. CertainTeed Diamond Deck.
c. Owens Corning ProArmo Sythetic Roof Underlayment.
d. Approved equal.

2.3 RIDGE VENTS

A. Rigid Ridge Vent: If shown, Manufacturer's standard, rigid section high-density polypropylene or other UV-stabilized plastic ridge vent with nonwoven geotextile filter strips and external deflector baffles; for use under ridge shingles. Available products include:
1. Cobra Ridge Vent II, by GAF Materials Corporation.
2. ShingleVent II, by Air Vent Inc., a CertainTeed Company.
3. Xtractor Vent X18, by Obdyke, Benjamin Incorporated.
4. Trimline Ridge Vent, by Trimline Building Products.

2.4 ACCESSORIES

A. Asphalt Roofing Cement: ASTM D 4586, Type II, asbestos free.

B. Roofing Nails: ASTM F 1667; aluminum, stainless-steel, copper, or hot-dip galvanized-steel wire shingle nails, minimum 0.120-inch- (3-mm-) diameter, barbed smooth shank, sharp-pointed, with a minimum 3/8-inch- (9.5-mm-) diameter flat head and of sufficient length to penetrate 3/4 inch (19 mm) into solid wood decking or extend at least 1/8 inch (3 mm) through OSB or plywood sheathing.
1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.

C. Felt Underlayment Nails: Aluminum, stainless-steel, or hot-dip galvanized-steel wire with low-profile capped heads or disc caps, 1-inch (25-mm) minimum diameter.

2.5 METAL FLASHING AND TRIM

A. General: Comply with requirements in Section 07 62 00 "Sheet Metal Flashing and Trim."
1. Sheet metal: Pre-finished aluminum, 0.032 inch thick or heavier.

B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of the item.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing site conditions under provisions of Division 01 and the following:
1. Roof penetrations and plumbing stacks are in place and flashed to deck surfaces.
2. Deck surfaces are dry and free of ridges, warps or voids.

3.2 ROOF DECK PREPARATION

A. Follow shingle manufacturer’s recommendations for acceptable roof deck material.

B. Broom clean deck surfaces under eave protection and underlayment prior to their application.

3.3 UNDERLAYMENT INSTALLATION

A. General: Comply with underlayment manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.

B. Single-Layer Felt Underlayment: Where felt is the indicated material as shown, on drawigns, install on roof deck parallel with and starting at the eaves. Lap sides a minimum of over underlying course. Lap ends a minimum of . Stagger end laps between succeeding courses at least . Fasten with felt underlayment roofing nails.
   a. Install felt underlayment on roof deck not covered by self-adhering sheet underlayment. Lap sides of felt over self-adhering sheet underlayment not less than 3 inches (75 mm) in direction to shed water. Lap ends of felt not less than 6 inches (150 mm) over self-adhering sheet underlayment.
   b. Install fasteners at no more than 36 inch (900 mm)o.c.

A. Self-Adhering Sheet Underlayment [SASU]: Install, wrinkle free, on roof deck. Comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install at locations indicated below on Drawings, lapped in direction to shed water. Lap sides not less than 3-1/2 inches (89 mm). Lap ends not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Roll laps with roller. Cover underlayment within seven days. Install SASU as shown on drawings but in no case less than the following:
1. 36 inch in each direction a dormers, cheek walls and valleys. As an example, at step flashing this requirement means 36 inches up vertical face and 36 inches along horizontal surface.
2. Not less than 36 inches at roof edge, nor less than 24 inches beyond the inside face of exterior wall inner face of finish, regardless of the distance of the fascia from the roof edge.

3.4 METAL FLASHING INSTALLATION

A. General: Install metal flashings and other sheet metal to comply with requirements in Section 07 62 00 "Sheet Metal Flashing and Trim."
1. Install metal flashings according to recommendations in ARMA's "Residential Asphalt Roofing Manual" and asphalt shingle recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."

3.5 ASPHALT SHINGLE INSTALLATION

A. General: Install asphalt shingles according to manufacturer's written instructions, recommendations in ARMA's "Residential Asphalt Roofing Manual," and asphalt shingle recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."

B. Install starter strip along lowest roof edge, consisting of an asphalt shingle strip with tabs removed at least 7 inches (175 mm) wide with self-sealing strip face up at roof edge.
1. Extend asphalt shingles 3/4 inch (19 mm) over fasciae at eaves and rakes.
2. Install starter strip along rake edge.

C. Install first and remaining courses of asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.

D. Install first and remaining courses of asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.

E. Install asphalt shingles by single-strip column or racking method, maintaining uniform exposure. Install full-length first course followed by cut second course, repeating alternating pattern in succeeding courses.

F. Fasten asphalt shingle strips with a minimum of six roofing nails located according to manufacturer's written instructions.
1. Where roof slope exceeds 20:12, seal asphalt shingles with asphalt roofing cement spots after fastening with additional roofing nails.
2. Where roof slope is less than 4:12, seal asphalt shingles with asphalt roofing cement spots, and apply over continuous self-adhering underlayment.
3. When ambient temperature during installation is below 50 deg F (10 deg C), seal asphalt shingles with asphalt roofing cement spots.

G. Closed-Cut Valleys: Extend asphalt shingle strips from one side of valley 12 inches (300 mm) beyond center of valley. Use one-piece shingle strips without joints in valley. Fasten with extra nail in upper end of shingle. Install asphalt shingle courses from other side of valley and cut back to a straight line 2 inches (50 mm) short of valley centerline. Trim upper concealed corners of cut-back shingle strips.

H. Ridge Vents: Install continuous ridge vents over asphalt shingles according to manufacturer's written instructions. Fasten with roofing nails of sufficient length to penetrate sheathing.

I. Ridge and Hip Cap Shingles: Maintain same exposure of cap shingles as roofing shingle exposure. Lap cap shingles at ridges to shed water away from direction of prevailing winds. Fasten with roofing nails of sufficient length to penetrate sheathing.
   1. Fasten ridge cap asphalt shingles to cover ridge vent without obstructing airflow.

END OF SECTION

SECTION 07 45 10 - FACTORY FINISHED WOOD FIBER-CEMENT ARCHITECTURAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Related documents: Drawings and general provisions of the Contract, and Division 01 Specification Sections, apply to this Section

B. Section Includes, without limitation, providing fiber cement:
1. Factory finished wood-fiber-reinforced cementitious architectural wall panels.
2. Standing & running trim, and corner accessories.
3. Factory undercoats, factory topcoats.
4. Application of factory touch up kit coatings.
5. Trim and installation accessories.
6. Accessories.
7. Rain screen assembly.

C. Extent: Fiber cement panels as shown.

D. Related Sections:
2. 07 25 10 – Sheet Weather Barriers.

1.2 SYSTEM DESCRIPTION & DEFINITIONS

A. System is based upon Nichiha architectural wall panels, a tongue & groove joint system with factory provided installation accessories and solid, textured and wood grain finishes depending upon series selected by architect and specified in this section. Panels are capable of horizontal and vertical installation depending upon series required.

B. DBVR: Drained and back-ventilated rainscreen system; designed to drain and dry cavity entering water through drainage channels, weeps, and air ventilation.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop drawings: Include details of panel dimensions, profiles, edge conditions, joints, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.

C. Samples:
1. Initial Selection: For panels, trim, installation components and related accessories.
2. Verification: For each type, color, texture, and pattern required.
3. 12-inch long-by-actual-width Sample of panels, soffits, trim and metal edging.

D. Qualification Data: For qualified siding Installer.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fiber-cement siding.

F. Research/Evaluation Reports: For each type of siding required.

G. Warranty: Sample of special warranty.

H. Maintenance Data: For each type of product and related accessories to include in maintenance manuals.

I. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.4 MAINTENANCE MATERIAL

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish full lengths of siding products including related accessories, in a quantity equal to 2 percent of amount installed.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by panel fabricator.

B. Labeling: Provide fiber-cement siding that is tested and labeled according to ASTM C 1186 by a qualified testing agency acceptable to authorities having jurisdiction.

C. Source Limitations: Obtain siding work including related accessories, from single source from single manufacturer.

D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockup of typical wall area as shown on Drawings, if not shown, as follows:
2. Build mockups for fiber cement including accessories.
   a. Size: Nominal 20 inches long by 60 inches high.
   b. Include outside corner on one end of mockup and inside corner on other end.
   c. Demonstrate corner detail, trim, typical siding installation and painting and sealant by others. Do not proceed with the work of this section until sample area is approved by the architect. The completed sample area shall remain as the quality and visual standard for the balance of the siding work. The sample area may be incorporated into the final work upon acceptance.

E. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials in a dry, well-ventilated, weathertight place.

1.7 COORDINATION & FIELD CONDITIONS

A. Coordinate installation with flashings and other adjoining construction to ensure proper sequencing.

B. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of panels to be performed in accordance with manufacturers' written instructions and warranty requirements

1.8 WARRANTY

A. Special Warranty: Standard form in which manufacturer agrees to repair or replace fiber cement that fail(s) in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
   a. Structural failures including cracking, deforming, and fading.
   b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
2. Warranty Period: 20, non-prorated years from date of Substantial Completion.
3. Warranty: Factory finish: 15 years, from substantial completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE – PHYSICAL, STRUCTURAL AND ENERGY

A. Comply with the following:
1. Physical Performance: Provide composite panel system in accordance with ASTM C1186.
   a. Wet Flexural Strength: Result: 1418 psi (9777 kPa), Lower Limit: 1015 psi (6998 kPa).
   b. Water Tightness: No water droplets observed on any specimen.
   c. Freeze-Thaw: No damage or defects observed.
   d. Warm Water: No evidence of cracking, delamination, swelling, or other defects observed.
   e. Heat-Rain: No crazing, cracking, or other deleterious effects, or surface or joint changes observed in any specimen.
2. Structural Performance: Provide composite panel systems capable of withstanding the effects of the following loads, based on testing in accordance with ASTM E330/E330M:
   a. Design Wind Loads: Minimum 58 psf.

b. Other Design Loads: As indicated on Drawings.
c. Deflection Limits: For wind loads, panel deflection no greater than L/120 of the span.

3. Thermal Expansion: Maximum 0.00000318 deg F to minus 1 (0.000005724 deg C to minus 1) when tested in accordance with ASTM E228.
4. Air Leakage: 1.53 cfm/sq. ft. (7.78 L/s/sq. m) or less in accordance with AAMA5094.
5. Water Penetration under Static Pressure: No water penetration to room side of assembly when tested for 15 minutes in accordance with ASTM E331 at the following test-pressure difference:
   a. Test-Pressure Difference: Equal or better than 2.86 lbf/sq. ft.
      2) .
6. Fire Propagation Characteristics: Composite panel wall assembly passes NFPA 285.
7. Surface-Burning Characteristics: Provide composite panels that meet the following values when tested in accordance with ASTM E84:
   a. Flame-Spread Index: Zero.
   b. Smoke-Developed Index: 5.
8. Fire Resistance: Composite panel wall assembly passes ASTM E119.
9. Ignition Resistance: Composite panel passes NFPA 268.

2.2 MANUFACTURERS

A. Subject to compliance with specifications, provide products from one of the following:
1. Cembrit.
2. Swisspearl.
3. Nichiha Fiber Cement.
4. James Hardie Building Products.

B. Basis of Design:
1. Manufacturer: Nichiha USA; ttp://www.nichiha.com/.
2. Series/Product: As shown or scheduled or as selected by Architect, to include:
   a. Designer Series.
   b. Vintage Wood Series.

2.3 FACTORY FINISHED WOOD FIBER CEMENT COMPOSITE ARCHITECTURAL WALL PANELS

A. Wall Panel Systems: Provide factory-formed and assembled, composite wall panels fabricated from a pressed, stamped, and autoclaved mix of portland cement, fly ash, silica, recycled rejects, and wood fiber bundles; formed into profile for installation method indicated. Include attachment assembly components and accessories required for weathertight system.

B. General: Meet or exceed ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E 136; with fire characteristics when tested according to ASTM E 84, as indicated below or better:
1. NFPA class A, does not ignite.
2. Rating: Non-combustible per ULC-S134.
3. Performance: Per Nichiha published literature, and as follows:
   a. Surface burning: Flame Spread: 0, Smoke Developed: 5.
4. Characteristics: As shown, if not, as follows:
   a. Thickness: 5/8 inch [16mm].
   b. Size: As shown, if not 18 H x 120 nominal, in inches [455 x 3030 mm].
   c. Weight/ 16 mm panel: 57.2 pounds.
   d. Density Dry: 1.580 kg/sm.
   e. Color range: 2 colors or more.
   f. Integrally colored, through body/core: No.
   g. Composition: Portland cement and fiber reinforced.
   h. Installation: Ship lapped, profiled edges; back vented, rainscreen method.
   i. Factory finished: 6 six sides.
   j. Panel material warranty: 50 year.
   k. Panel finish warranty: 15 year.
   l. Surface texture: As shown, if not, matte.
   m. Installable year round in cold climate: Yes.

n. Factory applied joint sealant: Yes.

C. Accessories: Provide manufacturer recommended assembly and rainscreen components including the following:
1. Color coated fasteners.
2. Fastener application: As shown, if not, face applied.

D. Ventilation strips at sills, heads and jambs.

E. EPDM backing strips over furring.

F. Texture: Per approved product.

2.4 FIBER-CEMENT SOFFIT

A. General: ASTM C 1186, Type A, Grade II, fiber-cement board, noncombustible when tested according to ASTM E 136; with fire characteristics when tested according to ASTM E 84, as indicated below or less:
1. Flame spread 25
2. Fuel contributed 0
3. Smoke density 5
4. NFPA class A
5. Basis-of-Design Product: Subject to compliance with requirements, provide product from same manufacturer as balance of project and as follows: Where shown, match adjacent finish product

B. Ventilation: Provide perforated, soffit unless otherwise indicated, with free area equal of 1/300 of vented area or more.

2.5 SUBFRAMING

A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet with ASTM A653/A653M, G90 (Z275) hot-dip galvanized coating designation or ASTM A792/A792M, Class AZ50 (Class AZM150) aluminum-zinc-alloy coating designation unless otherwise indicated. Provide Fabricator's standard sections as required for support and alignment of composite panel system.

2.6 INSTALLATION COMPONENTS

A. Ultimate Clip System:
1. Starter Track:
a. Horizontal Panel Installations - FA 700 – 3,030mm (l) galvalume coated steel.
b. Vertical Panel Installations (AWP-3030 only) – FA 710T – 3,030mm (l) galvalume coated steel.
2. Panel Clips: JEL 778 “Ultimate Clip II” (10mm rainscreen for 16mm AWP) – Zinc-Aluminum-Magnesium alloy coated steel.
a. Joint Tab Attachments (included) – used at all AWP-1818 panel to panel vertical joints, not used with AWP-3030 installations.
3. Corner Clips: JE 777C (10mm rainscreen for 5/8” AWP Manufactured Corners) -- Zinc-Aluminum-Magnesium alloy coated steel.
4. Single Flange Sealant Backer – FHK 1015 R (10mm) – 6.5’ (l) fluorine coated galvalume.
5. Double Flange Sealant Backer – FH 1015 R (10mm) – 10’ (l) fluorine coated galvalume.
6. Corrugated Spacer – FS 1005 (5mm), FS 1010 (10mm) – 4’ (l).

B. Essential Flashing System:
1. Starter – main segments (3,030mm), inside corners, outside corners
2. Overhang – main segments (3,030mm), inside corners, outside corners, joint clips

2.7 ACCESSORIES FOR FIBER CEMENT PANELS

A. 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 composite panels unless otherwise indicated.

B. Flashing and Trim: Provide aluminum flashing and trim 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.
   1. Aluminum Trim: Formed with 0.040-inch (1.00-mm-) thick, coil-coated aluminum sheet facings.
   2. Color: Match adjacent panels.

C. Panel Fasteners: Provide corrosion-resistant fasteners as required for construction method used.

D. Panel Sealants: ASTM C920, Class 35; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in composite panels and remain weathertight; and as recommended in writing by composite panel manufacturer.

E. Panel Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.
   1. Provide accessories made from same material as matching color and texture of adjacent siding unless otherwise indicated.

F. Aluminum Accessories: Where aluminum accessories are indicated, provide accessories complying with AAMA 1402.
   1. Texture: Smooth.
   2. Nominal Thickness: 0.040 inch or more.
   3. Finish: Manufacturer's standard, to match panels.

G. Decorative Accessories: Provide the following fiber-cement decorative accessories as indicated.
   1. Factory corner and other trim pieces in colors and finishes selected by Architect.
   2. Where shown, provide pre-finished aluminum Pittcon reveal shapes with self-flashing flanges.

H. Colors for Decorative Accessories: Match adjacent siding.

I. Fasteners: For integrally colored fiber cement components, use pre-finished color coated fasteners, match color of cement fiber. Use only stainless steel fasteners. Aluminum fasteners: Not permitted.

J. Insect Screening for Soffit Vents and where shown: Aluminum, 18-by-16.

2.8 AIR INFILTRATION BARRIER

A. Provide air infiltration under its own section in Division 7.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of siding and soffit and related accessories.

B. Ensure blocking and wood strapping provided by other sections is properly installed, is plumb, plane and true and will produce an acceptable result after installation is complete.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Condition work to average prevailing humidity conditions in installation areas prior to installing.

B. Deliver concrete inserts and similar anchoring devices to be built into substrates, well in advance of time substrates are to be built.

C. Clean substrates of projections and substances detrimental to application.

D. Prior to installation, examine shop fabricated work for completion, and complete work as required, including back priming and removal of packing.

3.3 SUBFRAMES/RAINSCREEN FURRING & ALIGNMENT ANGLES

A. Attachment Assembly, General: Install attachment assembly required to support composite wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.
   1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.

B. Refer to section 05 40 00 Cold formed metal framing and Division 06 for Wood blocking.

3.4 INSTALLATION -- GENERAL

A. Comply with manufacturer installation instructions and recommendations, except where more stringent requirements are specified. Use tools and cutting methods recommended.

B. General: Install composite panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor composite panels and other components of the Work securely in place, with provisions for thermal and structural movement.
   1. Shim or otherwise plumb substrates receiving composite panels.
   2. Flash or seal composite panels at perimeter of all openings. Fasten flashing with manufacturer-approved fasteners. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by composite panels are installed.
   3. Install screw fasteners in predrilled holes.
   4. Locate and space fastenings in uniform vertical and horizontal alignment.
   5. Install flashing and trim as composite panel work proceeds.
   6. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

C. Install work plumb, level, true and straight with no distortions. Shim as required using concealed shims.

D. Joints shall be tight and so formed as to conceal shrinkage or movement. Secure exposed work to prevent movement, checks or warps.

E. Work shall be properly framed, closely fitted and accurately set to the required lines and levels and shall be rigidly secured in place. Layout work before installation.

F. Scribe and cut work to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.

G. Cutting: In general cuts shall be made with saws. Where cut edges are exposed to view or weather use diamond blades.
   1. Miters: Take special care cutting miters. Use most skilled mechanics. Change saw blades at twice the recommended rate. Discard damaged, chipped, abraded or otherwise unsound or unacceptable cuts.

H. Work shall be free of defects or blemishes on surfaces exposed to view after final finish is applied. Replace any such work with new acceptable work.

3.5 FABRICATED ASSEMBLIES & SHAPES

A. Exterior decorative or finished work provided under this section, wherever practical, shall be cut to size and shape in the shop. Scrolls, shapes, and cutouts shall conform to detail and meet with the approval of the Architect before erection.

3.6 INSTALLATION OF CEMENT FIBER SIDING PANELS

A. Install cement fiber work over properly installed specified building paper or air barrier or furring system.

B. Lay butt joints only over stud or solid blocking. Do not use splice plates or other devices to install butt joints over spaces between studs or blocking.

C. Reveal joints: Provide solid backing at least 8 times width of joint. Use either matching cement board panel or pre-finished aluminum. Unless otherwise indicated ensure joint is caulked under its section. Do not expose blocking materials such as plywood or treated wood.

D. Where panel is required to be installed over concrete or masonry, fur out wall with fire retardant treated 1 x 2 inch wood framing spaced not more than 24 inches on center and secured to wall over a vapor barrier or specified building paper. Install furring vertically unless otherwise indicated.

E. Install approved corrosion resistant fasteners driven perpendicular to siding to a snug fit. Do not overdrive heads or drive at an angle. If fastener is countersunk, caulk hole with approved material. Use of staples is not permitted. Where pre-finished material is used, use pre-finished fasteners.

F. Provide pre-drilled holes for fasteners. Subject to review and approval by the Architect, repair minor dents and chips with approved cementitious patching compounds of type recommended by manufacturer. Replace cracked, damaged or unsightly panels with new work.

G. Corners: Install as shown; cut end piece with sharp saw along angle of beveled or sloped components.

H. Install joint sealants as specified in Section 07 92 00 "Joint Sealants" and to produce a weathertight installation or open joint system as indicated. Where not indicated provide weathertight system.

I. Fasteners: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

J. Attachment Assembly, General: Install attachment assembly required to support composite wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.
   1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.

K. Panel Installation: Attach composite wall panels to supports at locations, at spacings, and with fasteners recommended in writing by Fabricator to achieve performance requirements specified.
   1. DBVR Rainscreen System: Install using Fabricator's standard assembly with horizontal channel that provides support and secondary drainage assembly, draining at base of wall. Attach composite wall panels by placing panel clips to supports at locations, at spacings, and with fasteners recommended in writing by Fabricator.
      a. Track-Support Installation: Install support assembly at locations, at spacings, and with fasteners recommended in writing by manufacturer. Use Fabricator's standard horizontal tracks or drain channels that provide support and secondary drainage assembly. If not indicated, use drain channels.
      b. Panel Installation: Attach composite wall panels by interlocking panel edges with Fabricator's standard clips.
      c. Joint Sealing: Seal all joints in accordance with AAMA 509. Do not apply sealants to joints unless otherwise indicated.

L. Accessory Installation: 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 composite panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by composite panel Fabricator; or, if not indicated, provide types recommended in writing by composite system Fabricator.

M. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, or 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.
   1. Install exposed flashing and trim that is without 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 performance.
   2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 ft. (3 m) with no joints allowed within 24 inches (605 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).

3.7 INSTALLATION OF CEMENT FIBER SIDING PANELS RAINSCREEN INSTALLATION

A. Install cement fiber siding as indicated above. Install rainscreen systems over indicated substrate such as galvanized furring provided under other sections.

B. Ensure substrate, furring and the like is plumb, plane and true or that defects are corrected.

C. Ensure air pathways are clear and enclosed by insect mesh. Ensure water which penetrates assemblies is weeped and flashed out to daylight. Provide over-lapped flashing and pan and side flashing to ensure water may not back up into wall assemblies.

D. Install decorative trim, corners, reveals and the like where required or shown.

E. Install joint sealants as at all panels joints and where specified in Section 07 92 00 "Joint Sealants" and to produce a weathertight installation.

3.8 ERECTION TOLERANCES

A. Site Verifications of Conditions:
1. Verify that conditions of substrate previously installed under other Sections are acceptable for composite system installation. Provide documentation indicating detrimental conditions to composite system performance.
2. Once conditions are verified, composite system installation tolerances are as follows:
   a. Shim and align composite wall panel units within installed tolerance of 1/4 inch in 20 ft. (6 mm in 6 m), non-accumulative, on level, plumb, and location lines as indicated, and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.9 TOUCH-UP

A. Using manufacturer recommended touch-up kits or systems, touch up factory finishes to satisfaction of architect, and, where field finished, to satisfaction of painting trade or replace with new acceptable work.

3.10 CLEANING AND PROTECTION

A. Remove temporary protective coverings, if any, as composite panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of composite panel installation, clean finished surfaces as recommended by composite panel manufacturer. Maintain in a clean condition during construction.

B. After composite panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace composite panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

D. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION

SECTION 07 54 26 – ADHERED TPO MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Adhered thermoplastic polyolefin sheet roofing.
2. Vapor retarder.
3. Roof insulation.
4. Walkway pads.

C. Related Sections include the following:
1. Division 6 Section "Blocking" for wood nailers, curbs, and blocking; and wood-based, structural-use roof deck panels.
2. Division 7 Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings and counter flashings.
3. Division 7 Section "Joint Sealants."
4. Division 25 Section "Plumbing Specialties" for roof drains.

1.2 DEFINITIONS

A. Roofing Terminology: Refer to ASTM D 1079 for definition of terms related to roofing work not otherwise defined in this Section.

B. TPO: Thermoplastic polyolefin.

1.3 REFERENCED CODES AND STANDARDS

A. All references to codes, specifications and standards referred to herein shall become a part of this section as though written out, and shall mean, and is intended to be the latest edition, amendment, and/or revision of such reference unless otherwise specified.

AA	-	Aluminum Association.
AAMA	-	Architectural Aluminum Manufacturer's Association.
ASTM	-	American Standards for Testing and Materials.
FM	-	Factory Mutual Engineering Corporation.
FS	-	Federal Specification.
SMACNA	-	Sheet Metal & Air Conditioning Contractors National Assoc., Inc.
UL	-	Underwriters Laboratories, Inc.

1.4 U.L., FM LISTING AND REGULATORY REQUIREMENTS

A. Underwriter's Laboratories, Inc. (U.L.) Class A Fire Hazard Classification, Class 1 Construction.

B. Factory Mutual Engineering Corporation (FM) [aka FM Global] requirements:
1. Applicable assemblies: At least, Roofing, base flashings, and component materials.
2. FM Standards: FM Global 4450 or FM Global 4470 as part of a roofing system.
3. FM Listing: "RoofNav" for Class 1 or noncombustible construction, as applicable.
4. Roof Assembly Classification/ Listing per Loss Prevention Data Sheet 1-28:
   a. "RoofNav" for Class 1 or noncombustible construction as applicable.
   b. Fire classification: 1A.
   c. Windstorm classification [in pounds per square foot of uplift]: As specified below.
   d. Hail-resistance rating: SH.

C. In addition, follow local, state and federal regulations, safety standards and codes. When a conflict exists, use the stricter documents.

D. All materials used in the roofing system must be FM approved and must have been tested together as part of a complete roofing assembly.

1.5 PERFORMANCE REQUIREMENTS

A. General: Install sheet membrane roofing and base flashing that are watertight; will not permit the passage of liquid water; and will withstand wind loads, thermally induced movement, and exposure to weather without failure.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing system manufacturer based on testing and field experience.

C. FM Listing: Provide sheet membrane, base flashings, and component materials that meet requirements of FM 4450 and FM 4470 as part of a roofing system and that are listed in FM's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM markings.
1. Roofing system shall comply with the following:
   a. Fire/Windstorm Classification: Class 1A-120.

D. Roofing System Design: Provide a single-ply roofing system that complies with roofing system manufacturer's written design instructions and with the following:
1. SPRI's "Wind Design Guide for Adhered Roofing Systems."
2. Roofing material with a Solar reflective index equal or greater than 78.

1.6 SUBMITTALS

A. Product Data: For each type of roofing product specified. Include data substantiating that materials comply with requirements.

B. Shop Drawings: Include plans, sections, and details of the following:
1. Layout and thickness of insulation.
2. Base flashings and membrane termination details.
3. Flashing details at penetrations.
4. Tapered insulation layout, thickness, and slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof location as required to withstand wind uplift conditions.
7. Tie-in with adjoining air barrier.

C. Samples for Verification: Of the following products:
1. Square of sheet roofing, of color specified, including T-shaped side and end lap seam.
2. Square of roof insulation.
3. Square of walkway pads.
4. Length of metal termination bars.
5. 6 insulation fasteners of each type, length, and finish.
6. 6 roof cover fasteners of each type, length, and finish.
7. Locations of temporary daily stop of work.

D. Wind load calculations: Submit basic wind uplift calculations for field, perimeter and corners, per requirements of FM Global Data Sheet 1-28 requirements.

E. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install specified roofing system.

F. Manufacturer Certificates: Signed by roofing manufacturer certifying that the roofing system complies with requirements specified in the "Performance Requirements" Article. Upon request, submit evidence of meeting requirements.

G. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

H. Product Test Reports: Based on evaluation of tests performed by manufacturer and witnessed by a qualified independent testing agency, indicate compliance of components of roofing system with requirements based on comprehensive testing of current product compositions.
1. Research/Evaluation Reports: Evidence of roofing system's compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.

I. Maintenance Data: For roofing system to include in the maintenance manuals specified in Division 1.

J. Warranty: Sample copy of roofing system manufacturer's warranty stating obligations, remedies, limitations, and exclusions of warranty. Warranty shall provide for a wind speed as specified or more.

K. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

L. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.
1. Provide test reports indicating initial and 3 year solar reflectance for installed materials exposed to view or sunlight.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer to perform work of this Section who has specialized in installing roofing similar to that required for this Project for at least 5 years and who is approved, authorized, or licensed by the roofing system manufacturer to install manufacturer's product.

B. Fire-Test-Response Characteristics: Provide roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method indicated below by UL, FM, or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
1. Exterior Fire-Test Exposure: Class A; ASTM E 108, for application and slopes indicated.
4. Fire-Resistance Ratings: ASTM E 119, for fire-resistance-rated roof assemblies of which roofing materials are a part.

C. Preinstallation Conference: Before installing roofing system, conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings." Notify participants at least 5 working days before conference.
1. Meet with Owner; Architect; Owner's insurer, if applicable; testing and inspecting agency representative; roofing Installer; roofing system manufacturer's representative; deck Installer; and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Parties shall review and resolve all issues regarding specifications, roof plan, membrane and metal flashing details and U.L. and FM requirements.
3. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review loading limitations of deck during and after roofing.
6. Review flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing.
7. Review governing regulations and requirements for insurance, certificates, and inspection and testing, if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.
10. Document proceedings, including corrective measures or actions required, and furnish copy of record to each participant.

1.8 TESTING OF FASTENERS

E. Field testing of fasteners will be required. Fasteners within each roof area for purposes of securing insulation and membrane shall be tested for minimum pull-out resistance as listed below. Provide not less than 2 pull-out locations determined at pre-roofing conference. A report of the findings shall be forwarded to the Architect. Testing shall be performed by the fastener manufacturer without additional cost.

Deck Type	**Min. Pull-Out Resistance in Pounds**
Steel deck, 22-gage or heavier:	425
Structural concrete, 3,000 psi or greater:	800
Light weight insulation concrete:	360
Wood plank and plywood:	360

1.9 PRODUCT REQUIREMENTS / DELIVERY, STORAGE AND HANDLING / COMPATIBILITY

B. Comply with Division 1, delivery storage, handling, product requirement and product compatibly provisions and the following:
1. Storage area shall be shaded, ventilated and maintained at a temperature recommended by the materials manufacturer, and shall be located away from all sources of excess heat, sparks or open flame. Containers of liquid material shall not be left open at any time in the storage area.
2. Deliver work under this section to site in ample time to avoid delay in job progress and at such times as to permit proper coordination.
3. Separate modified bitumens from materials such as EPDM and plasticizers affected by petroleum based materials and solvents.
4. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
5. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
6. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.10 PROJECT CONDITIONS

A. Weather Limitations: Proceed with roofing work only when existing and forecasted weather conditions permit roofing to be installed according to manufacturers' written instructions and warranty requirements.

1.11 WARRANTY

A. General Warranty: The warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Roofing Manufacturer's Warranty: Submit a written warranty, without monetary limitation, signed by roofing system manufacturer agreeing to promptly repair leaks resulting from defects in materials or workmanship for the following warranty period:
1. Warranty Period: 15 years minimum. Provide price for providing 30 year warranty.
2. Extended wind speed: Provide extended wind speed warranty for wind gust speeds as specified below. Attention is directed to installers that manufacturers review and approval is required before installation of the extended wind speed.

F. Extended wind speed coverage: Provide extended wind speed warranty coverage to not less than 110 miles per hour.
1. At time of bidding, advise Owner in writing of additional or reduced cost of warranties for the following wind speeds:
   a. 110 to 90 miles per hour.
   b. 110 to 120 miles per hour.

C. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering Work of this Section, including membrane roofing, sheet flashing, roof insulation, fasteners, and vapor retarders, if any, for the following warranty period:
1. Warranty Period: 2 years from date of Substantial Completion.

D. In-place field sample mock-up: Provide 100 square foot or larger installation in a corner demonstrating all assembling and installation conditions. Include penetrations, horizontal to vertical joints and the like.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide sheet roofing products by one of the following:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Thermoplastic Polyolefin (TPO) Sheet:
   a. Carlisle Syntec Systems; Carlisle Corp.
   b. Firestone Building Products Co.
   c. Johns Manville Co.
3. Polyisocyanurate Board Insulation: Use membrane manufacturer board where required by warranty.
   a. Apache Products Co.
   b. Atlas Roofing Corporation.
   c. Celotex Corp. (The).
   d. GAF Materials Corp.
   e. NRG Barriers, Inc.

2.2 THERMOPLASTIC POLYOLEFIN SHEET [TPO]

A. Reinforced Thermoplastic Polyolefin Sheet: Uniform, flexible elastomer sheet formed from a thermoplastic polyolefin, reinforced, of the following thickness, exposed face color, and physical properties:
1. Acceptable Product: Carlisle “Sure-Weld TPO”.
2. Thickness: 80 mils (2.0 mm), nominal.
3. Exposed Face Color: As selected or shown, if not, Whit
4. Physical Properties: Provide reinforced thermoplastic polyolefin sheets with the following properties as determined per ASTM test method indicated:
   a. Minimum Breaking Strength: 225 lbf (1 kN); ASTM D 751, grab method.
   b. Minimum Elongation at Break: 25 percent typical; ASTM D 751.
   c. Tearing Strength: 55 lbf (245 N) minimum; ASTM D 751, Procedure B.
   d. Resistance to Heat Aging: No reduction in breaking strength, elongation at break, and tearing strength after 168 hours at 240 deg F (116 deg C); ASTM D 573.
   e. Ozone Resistance: No cracks after 168 hours' exposure of 50 percent elongated sample at 100 deg F (38 deg C) and 100-pphm (100-MPa) ozone; ASTM D 1149, Procedure B, specimen wrapped on 3” mandrel.
   f. Water Absorption: Less than 4 percent mass change after 168 hours' immersion at 158 deg F (70 deg C); ASTM D 471.
   g. Weather Resistance: No cracks or crazing after 4000 hours' exposure to xenon-arc; ASTM G 26.
   h. Solar reflectance index: Provide a minimum SRI of 78, per ASTM E1980.

2.3 AUXILIARY MATERIALS

A. General: Furnish auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing material.
1. Furnish liquid-type auxiliary materials that meet VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, thickness, and color as sheet membrane.

C. Bonding Adhesive: Manufacturer's standard bonding adhesive.

D. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

E. Metal Termination Bars: Manufacturer's standard aluminum bars, approximately 1 inch (25 mm) wide, roll formed and prepunched.

F. Metal Battens: Manufacturer's standard aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch (25 mm) wide by 0.05 inch (1.3 mm) thick, pre-punched.

G. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions of FM 4470, designed for fastening sheet to substrate, and acceptable to roofing system manufacturer.

H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, seam calk, termination reglets, and other accessories recommended by roofing system manufacturer for intended use.

K. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions of FM 4470, designed for fastening thermal barrier to substrate.

2.4 UNDERLAY & INSULATION COVER [AKA RECOVER] BOARD

A. Underlay board [aka fire/thermal barrier]: Where shown on drawings, provide:
1. Type X, ASTM C36, glass mat faced board fire-tested, gypsum board meeting the following:
2. DensDeck, or if required for application, Dens Deck Prime.
3. Approved equal.
4. Thickness: As shown, if not, 0.625 inch thick or more.
5. Usage: As shown, if not, directly attached to structural deck or sheathing.
6. Not required for flat solid decking such as poured in place concrete slabs.

B. Insulation Cover [aka “Recover Board”]: Provide roof board fire-tested, high density polyisocyanurate with glass-mat facers and a pre-primed surface on one side acceptable to manufacturer and equal to and meeting the following:
1. Carlisle SecurShield HD
2. Johns Manville Invinsa FR
3. Firestone Isogard HD
4. Hunter Panels H-Shield DS
5. Thickness: 0.50 inch.
6. Mechanically fasten to provide indicated warranty and wind speed rating.
7. Fiber board: Not an acceptable substitute.
8. Use only products acceptable to roofing manufacturer and capable of provide required warrantees.

2.5 VAPOR BARRIER

A. Provide vapor barriers if shown, or if part of assembly required by manufacturer for warranty.

B. Vapor barrier shall be U.L. approved reinforced air vapor retarder meeting perm rating of 0.05 or better, and UL requirements for application on project decks. Provide non-slip, peel and stick sheets secured to glass mat faced board from one of the following:
1. Carlisle VapAir Seal 725TR.
2. Firestone V-Force Vapor Barrier membrane.
3. Soprema Sopravap’R vapor barrier.

C. Provide manufacturer's recommended primers and roofing adhesives for application of barrier, manufactured free of asphalt compounds and designed for deck application matching project conditions.

2.6 INSULATION MATERIALS

A. General: Provide preformed roof insulation boards that comply with requirements, selected from manufacturer's standard sizes and of thicknesses indicated.
1. Provide preformed, tapered insulation boards where indicated for sloping to drain. Fabricate with the following taper:
   a. 1/4 inch per 12 inches (1:48) minimum, unless otherwise indicated – typical slope.
   b. 1/2 inch per 12 inches (1:48) minimum, at roof drainage crickets
2. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated or specified, whichever is greater.

B. Required R rating: As shown, if not, R = 30 minimum.

C. Polyisocyanurate Board Insulation: Rigid, cellular polyisocyanurate thermal insulation with core formed by using HCFCs as blowing agents to comply with ASTM C 1289, classified by facer type as follows:
1. Facer Type: Type II, felt or glass-fiber mat on both major surfaces.
2. Facer Type: Type IV, cellulosic-fiber insulating board, ASTM C 208, Type II, Grade 2, 1/2 inch (12.7 mm) thick on 1 major surface and a felt or glass-fiber mat on the other.

2.7 INSULATION ACCESSORIES

A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatible with sheet roofing material.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions of FM 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

C. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric mat, water permeable and resistant to ultraviolet degradation, type and weight as recommended by roofing system manufacturer for application.

2.8 WALKWAYS

A. Walkway Pads: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads, approximately 3/16 inch (5 mm) thick, of materials acceptable to roofing system manufacturer.
1. Usage: Where shown and around roof top equipment requiring maintenance and roof egress and ingress pathways.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions under which roofing will be applied, with Installer present, for compliance with requirements.

B. Verify that roof openings and penetrations are in place and set and braced and that roof drains are properly clamped into position.

C. Verify that wood nailers are in place and secured and match thicknesses of insulation required.

D. Concrete deck substrates: Do not proceed with installation until after the minimum concrete curing period recommended by roofing system manufacturer. Test substrates and submit results in writing along with manufacturer maximum recommended moisture recommendations.
1. Moisture Testing/ chloride testing: Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates do not exceed a maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
2. Moisture meter testing: Comply with ASTM F2170-02 Probe Test for Determining relative humidity. Use Wagner Rapid RH probes, unless otherwise approved.

E. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of the roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.3 UNDERLAY / FIRE-THERMAL BARRIER

A. Install thermal barrier with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt thermal-barrier boards together.
1. Secure thermal barrier to top flanges of steel deck according to recommendations of FM's "Approval Guide" for specified Windstorm Resistance Classification.
2. Secure thermal barrier to top flanges of steel deck using at least 1 fastener for each 4 sq. ft. (0.38 sq. m) and at least 2 fasteners per board.

B. Install slip sheet over deck before application of insulation.

3.4 VAPOR-RETARDER INSTALLATION

A. Install laminate-sheet vapor retarder in a single layer over area to receive vapor retarder, side and end lapping each sheet a minimum of 2 inches (50 mm) and 6 inches (150 mm), respectively. Bond vapor retarder to deck as follows:
   1. For self-adhesive types: Prime substrate, roll into place, free of bubbles, fish mouths and wrinkles.
   2. Tape laps and edges where recommended by manufacturer.

B. Completely seal vapor retarder at terminations, obstructions, and penetrations.

3.5 INSULATION INSTALLATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system manufacturer's written instructions for installing roof insulation.

C. Install tapered insulation under area of roofing to conform to slopes indicated and to Shop Drawings.

D. Install one or more layers of insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2 inches (50 mm) or greater, install required thickness in 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.
   1. Provide insulation to minimum R value indicated on drawings. Where not indicated, provide a minimum R value as specified.

E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
   1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
   2. Loosely Laid Insulation: Loosely lay insulation units.

G. Attached Insulation: Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m) and allow primer to dry. Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature and at a rate required by insulation manufacturer.
   1. Installers may use manufacturer’s approved attachment method such as Sure-Seal FAST Adhesive where manufacturer makes a product specifically for the application in question.
   2. Verify bond and uplift capacity complies with requirements before proceeding. Check field, perimeter and corner conditions.

H. Attached Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type indicated.

I. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Loosely butt cover boards together and fasten to roof deck according to roofing system manufacturer's written instructions.

J. Compliance and verification:
   1. Secure, fasten or attach insulation according to requirements of FM's "Approval Guide" for specified Windstorm Resistance Classification and the insulation and roofing system manufacturers' written instructions.
   2. Verify bond and uplift capacity complies with requirements before proceeding. Check field, perimeter and corner conditions.

3.6 RECOVER BOARD INSTALLATION

A. Install board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt boards together.
   1. Secure board to structural substrate according to recommendations of FM's "Approval Guide" for specified Windstorm Resistance Classification, but not less than the following:

3.7 ADHERED SHEET INSTALLATION

A. Install thermoplastic sheet over area to receive roofing according to roofing system manufacturer's written instructions. Unroll sheet and allow to relax for a minimum of 30 minutes.
   1. Install sheet according to ASTM D 5036.

B. Start installation of sheet in presence of roofing system manufacturer's technical personnel.

C. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Apply bonding adhesive to substrate and underside of sheet at rate required by manufacturer and allow to partially dry. Do not apply bonding adhesive to seam area of sheet.
   1. Apply a solid mopping of hot roofing asphalt, at a rate required by roofing system manufacturer, to substrate and install fabric-backed sheet. Keep seam area and remainder of sheet free of asphalt.

E. Mechanically fasten sheet securely at terminations and perimeter of roofing.

F. Apply roofing sheet with side laps shingled with slope of roof deck where possible.

G. Spread sealant bed over deck drain flange at deck drains and securely seal roofing sheet in place with clamping ring.

H. Install adhered thermoplastic sheet and auxiliary materials to tie in to existing roofing.

3.8 SEAM INSTALLATION

A. Clean seam areas, overlap sheets, and weld side and end laps of sheets and flashings according to manufacturer's written instructions to ensure a watertight seam installation. Weld seam as follows:
   1. Weld Method: Hot air.

B. Test lap edges with probe to verify seam weld continuity. Apply seam calk to seal cut edges of sheet membrane, after weld is confirmed

C. Repair tears, voids, and lapped seams in roofing that does not meet requirements.

D. Clean membrane after roof top construction is complete.

3.9 FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrate according to roofing system manufacturer's written instructions.

B. Minimum flashing height: 8 inches.

C. Apply bonding adhesive to substrate and underside of flashing sheet at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.

D. Flash penetrations and field-formed inside and outside corners with sheet flashing as recommended by manufacturer.

E. Clean seam areas, overlap sheets, and firmly roll flashings into the adhesive. Weld side and end laps to ensure a watertight seam installation.

F. Test lap edges with probe to verify seam weld continuity. Apply lap sealant and seal exposed edges of sheet flashing terminations.

G. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.
   1. At vertical applications higher then 36 inches, provide battens to secure membrane. Over lap batten with succeeding sheet and heat weld seam.

3.10 WALKWAY PAD INSTALLATION

A. Walkways: Install walkway pads in locations indicated. Heat weld or adhere walkway pads to substrate with compatible adhesive according to roofing system manufacturer's written instructions. Periodically space walkway pads several inches apart to provide break for future re-roofing or repairs.

B. Provide walk way pads at elements on membrance surface such as photo-electric arrays, sleepers or underdeck pedestals.

3.11 FIELD QUALITY CONTROL

A. Verify field strength of seams a minimum of twice daily, according to manufacturer's written instructions, and repair seam sample areas.

B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.
1. Notify Architect or Owner 48 hours in advance of the date and time of inspection.

3.12 FIELD TESTING

A. Comply with the following:
1. Test or probe seams using qualified personnel authorized by roofing manufacturer. Perform testing of field auto-welded and hand made seams.
2. Perform destructive seam test at beginning of each day and whenever welding process is interrupted.
3. Retain samples on site date, location, time, and unique conditions labeled for review by the architect/engineer.
4. Arrange for a representative of roofing manufacturer to visit site during mockups, pre installation meeting, and twice during construction. Manufacturer shall confirm that roofing system is being installed in accordance with manufacturer's specifications, requirements and recommendations applicable to site, region and project.
5. Obtain and submit manufacturer's written report.
6. Conduct fastener pull-out tests in accordance with ANSI/SPRI FX-1, current edition. Conduct at least 5 tests on each fastener proposed for use on the project in each different type of substrate.
7. For adhered insulation systems, perform a bonded uplift test to sheet membrane installation.
8. Flood testing: Test at least 3 drains by plugging drain and flooding a 100 square foot area for 48 hours; followed by an infrared survey of completed roof assembly. Notify Architect at lest 72 hours before testing. Submit test results.
9. Thermal anomalies: If flood testing or infrared scans indicate possible leakage or moisture, follow-up with test cuts into roofing assembly. Replace wetted materials and defective work at no cost to Owner.

3.13 PROTECTING AND CLEANING

A. Protect sheet membrane roofing from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing 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 that does not comply with requirements, repair substrates, reinstall roofing, and repair sheet flashings to a condition free of damage and deterioration at the time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures required by manufacturer of affected construction.

END OF SECTION

SECTION 07 62 00 - SHEET METAL FLASHING & TRIM

PART 1 GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Sheet metal flashing and trim.
2. Standards and requirements for flashing furnished and installed by others.

C. Related sections and work
1. 07 53 26 – Adhered PVC Roofing
2. 07 65 10 - Flashing built into Masonry Walls.
3. 07 71 15 Manufactured Roof Edges.
4. 07 71 23 Manufactured Gutters & Downspout.
5. 07 72 10 Snow Guards.

1.2 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies 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. Conform to the following requirements:
1. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
2. 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.
3. SPRI Wind Design Standard: Manufacture and install copings roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.

C. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.

D. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.4 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.

B. Source Limitations: Obtain materials of a uniform quality, including color for exposed work, from single manufacturer for each component.
1. Standards: Comply with applicable requirements, recommendations and details of SMACNA *Architectural Sheet Metal Manual*.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. In general, provide manufactured products, where not practical, shop fabricate work. Acceptable manufactures include:
1. Beach Sheet Metal Co., Inc.; Berger Building Products, Inc.; Englert, Inc.; Fiberweb Clark/Hammerbeam Corp.; Hohmann & Barnard, Inc.; National Sheet Metal Systems, Inc.; Nervastral Inc.; Petersen Aluminum Corp.; Quickflash Weatherproofing Products, Inc.; Sandell Construction Solutions; SBC Industries Flashings; or approved equal.

2.2 APPLICATIONS

A. Applications are as shown.

2.3 MATERIALS

A. Provide materials shown, but complying with the following minimum gages, composition and types:
1. Metal: Sheet aluminum.
   a. Standard: ASTM B 209, alloy 3003,
   b. Thickness As shown, if not, 20 gauge (.0359 inch).
   c. Exposed Finish [visible]: Prefinished 2-coat 70 percent fluoropolymer
   d. Concealed Finish: Clear anodized or prefinished 2-coat 70 percent fluoropolymer.
2. Laminated Composition Sheet Flashing: 5 ounce copper sheet laminated between 2 layers of bituminous impregnated Kraft paper or saturated fabric. Furnish and install under Section 04 01 05.

C. Zinc-Coated Copper Flashing: Provide 16 oz. per sq. ft., cold-rolled, copper sheet conforming to ASTM B 370, H00 temper, coated with zinc at rate of 7-1/2 lb. per side per 100 sq. ft., conforming to ASTM B 101, type 1, class A.

D. Tin-Zinc Copper alloy:
1. Basis of design: Revere FreedomGray
2. Material: Sheet copper standard, ounce-weight meeting to ASTM B370.
3. Copper coating: Coated both sides with Tin/Zinc alloy a minimum of 0.0005" thick per side.
4. Alloy composition: Approximately 50% zinc and 50% tin with trace elements controlled for durability, corrosion resistance and color.

E. “Lead” flashing: Where drawings refer to “lead” flashing, use dead soft, untempered stainless steel, as follows:
1. Acceptable product/ supplier: [for through wall applications] Mastercraft Metals Interlocking Mechanically-keyed Through-Wall Flashing; www.mastercraftmetals.net/.
2. Material: Stainless Steel, per ASTM A 167, type 302/304, 2D finish [aka, dull rough finish, with lead-like appearance].
3. Temper: Fully annealed or dead soft temper.
4. Through wall applications configurations:
   a. Mechanically-keyed with ribs formed at 3" intervals in a
   b. Sawtooth, interlocked pattern to provide positive bond to mortar and allow drainage of moisture to exterior.

2.4 MISCELLANEOUS MATERIALS

A. Components include:
1. Fasteners: Match material being fastened for both type of material and finish.
2. Isolation Coating: SSPC paint 12.
3. Slip Sheet: 5 lb. rosin building paper.
4. Plastic Underlayment: 6 mil carbonated polyethylene film, FS L-P-512.
5. Reglets: Metal units of type and profile indicated or required which are compatible with flashings used.
6. Solder: ASTM B 32, as required.

7. Accessories: Provide all clips, cleats, straps, anchors and similar items necessary to properly complete the work. Provide accessories that are compatible with sheet metal materials used and which are of sufficient size and gage to perform as intended.
8. Elastomeric Sealant: ASTM C 920, 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.
9. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
10. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.
11. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.5 FABRICATION

A. Shop fabricate work to the greatest extent possible. Fabricate work to be truly straight, plumb, level and square, and to provide the best possible watertight, weatherproof performance with expansion provisions in running work.

B. Provide work to sizes, shapes, and profiles indicated on approved shop drawings. Comply with referenced standards. Minimize oil-canning, buckling, tool marks and other defects.

C. Make work with uniform, watertight joints. Make seams as inconspicuous as possible.

D. Isolate dissimilar materials with isolation coating or other permanent separation acceptable to the Architect.

E. Scuppers: Make work to detail shown, if not, comply with CDA or SMACNA reference manuals for applications indicated.

F. Relief bends:
1. Make bends at least equal to material thickness plus inside bend radius.
2. Provide at exposed sections wider larger than 10 inches wide.

PART 3 EXECUTION

3.1 GENERAL

A. Comply with the provisions of Section 01 70 00 - especially requirements related to:
3. Inspection and examination. Tolerances and measurement.
4. Approvals, inspections and filed quality control.
5. Layout. Adjusting.
6. Cleaning. Protection.

3.2 EXAMINATION

A. Examine and verify conditions per Section 01 70 00 and as follows:
1. Verify substrates and underlying work is within tolerances specified.
2. Verify structural components are properly placed.
3. Before installation, examine rough-in and built-in construction for mechanical/electrical and other systems to verify actual locations of connections.
4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 TOLERANCES

A. For exposed work, the following allowable installed tolerances are allowable variations from locations and dimensions indicated by the Contract Document and shall not be added to allowable tolerances indicated for other work.
1. Allowable Variation from True Plumb, Level, and Line: +/- 1/8" in 20'-0"
2. Allowable Variation from True Plane of Adjacent Surfaces: +/- 1/16"

B. Other Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.4 INSTALLATION

A. Install flashing in continuous uninterrupted manner to accomplish 'intent' complete with all transitions, laps, splices, folds, seams necessary to ensure the diversion of water to the exterior. Work in close coordination with installation of exterior masonry, roofing, window, joint sealer, louver, and the like.
   1. Apply materials within manufacturer's requirements for temperature and weather conditions.
   2. Do not apply to wet or frozen substrates.
   3. Do not allow contamination with dust or dirt.
   4. Seal completely at edges, perimeter and penetrations.

B. Strictly comply with manufacturer's instructions and recommendations and standard details and recommendations of SMACNA, except where more restrictive requirements are specified in this section. Locked and sealant locked joints as indicated on the Drawings.

C. Securely anchor work, but allow for thermal movement and building movement. Use concealed fasteners to the greatest extent possible. Install work to be permanently weatherproof and watertight. Provide continuous cleats at all edge conditions.

D. Provide reglets where indicated and where required. Coordinate installation with related and adjacent work.

E. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
   1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
   2. Use lapped expansion joints only where indicated on Drawings.

F. Fasteners: Use fastener sizes that penetrate wood or sheathing substrate not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws and for other substrates not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

G. Through-wall flashing at masonry walls:
   1. Overlap adjacent pieces of flashing minimum 2" and roll all overlaps with steel hand roller.
   2. Trim bottom edge of flashing minimum of 1/2" back from exposed face of the building.
   3. Rivet or staple vertical and horizontal joints.
   4. At sheet metal seams, full solder non-moving joints.
   5. Apply a bead of sealant along top edge of flashing membrane and along seams and cuts as necessary and as recommended by manufacturer.

G. Provide flashing at every obstruction to the downward flow of water. Design and install flashing to control and divert water to the exterior. Form at least 4" high end pans above lintels and similar conditions to extend the entire length of the lintel where possible. Flashing shall extend 4" minimum beyond end of lintel before it is panned (dammed).

3.5 FIELD QUALITY CONTROL

A. Owner Testing and Inspecting: Owner may engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as

B. Installer Testing and Inspecting:
   1. Flood test large areas of sheet metal work to test reliability of soldered seams and substrates.

END OF SECTION

SECTION 07 65 10.1 - FLASHING BUILT INTO MASONRY WALLS

PART 1 - GENERAL

1.1 SUMMARY

A. Related documents: Drawings and general Contract provisions, and Division 1 Specification Sections, apply to this Section.

B. Section Includes, without limitation, providing:
1. Embedded flashing built into masonry walls.

C. Related Sections:
1. Section 07 62 00 - Sheet metal flashing & trim.

1.2 SUBMITTALS

A. Comply with Division 01 General Requirements and submit for approval:
1. Product Data: Manufacturer's literature including installation instructions, use restrictions and limitations.
2. Shop drawings: Large scale drawings for fabrication, installation of head, jamb, sill and joining details. Provide templates for work installed by others.
   a. Field Measurements: Take accurate field measurements before fabrication and indicate same on shop drawings.
3. Mock-Up/Field Samples: Prior to installation, provide mock up of each type of system proposed for use for approval. Accepted mock-ups may be incorporated into the work unless otherwise noted.
   a. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

B. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Pre-installation Conference: Conduct conference at Project site.

PART 2 - PRODUCTS

2.1 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual and Division 7 Section "Sheet Metal Flashing and Trim" and as follows:
1. Stainless Steel: ASTM A 240/A 240M, Type 304, 2D dull, cold rolled finish, temper as required for the application in thickness as follows:
   a. Typical application 0.0156 inch thick.
3. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
4. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
5. Fabricate through-wall flashing with sealant stop unless otherwise indicated. Fabricate by bending metal back on itself 3/4 inch (19 mm) at exterior face of wall and down into joint 1/4 inch (6 mm) to form a stop for retaining sealant backer rod.
   a. Fabricate metal drip edges for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam will shed water.
6. Metal Drip Edge: Fabricate 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.
7. Metal Expansion-Joint Strips: Fabricate from stainless steel or copper to shapes indicated, to match typical metal used.

B. Flexible Flashing: Use one of the following unless otherwise indicated:

1. Copper-Laminated Flashing: copper sheet bonded between 2 layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry in the following thickness:
   a. 7-oz./sq. ft.
   b. Products: Subject to compliance with requirements, products include:
      1) Advanced Building Products Inc.; Copper Fabric Flashing. .
      2) Dayton Superior Corporation, Dur-O-Wal Division; Copper Fabric Thru-Wall Flashing.
      3) Hohmann & Barnard, Inc.; H & B C-Fab Flashing.
      4) Sandell Manufacturing Co., Inc.; Copper Fabric Flashing.
      5) York Manufacturing, Inc.; Multi-Flash 500.

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 (1.02 mm)].
   a. Products: Subject to compliance with requirements, [provide one of the following:
      1) Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
      2) Fiberweb, Clark Hammerbeam Corp.; Aquaflash 500.
      3) Grace Construction Products, W. R. Grace & Co. - Conn.; Perm-A-Barrier Wall Flashing.
      4) Heckmann Building Products Inc.; No. 82 Rubberized-Asphalt Thru-Wall Flashing.
      5) Hohmann & Barnard, Inc.; Textroflash.
      6) W. R. Meadows, Inc.; Air-Shield Thru-Wall Flashing.
      7) Sandell Manufacturing Co., Inc.; Sando-Seal.
      8) Williams Products, Inc.; Everlastic MF-40.
   b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
   a. Products: Subject to compliance with requirements, provide one of the following:
   e. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

C. Application: Unless otherwise indicated, use the following:
   1. Where flashing is indicated to receive counterflashing, use metal flashing.
   2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
   3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing:
      a. With a drip edge with a sealant stop
   4. Where flashing is fully concealed, use flexible flashing.

D. Single-Wythe CMU Flashing System: Sandell Manufacturing Co., Inc.; Blok-Flash.

E. Solder and Sealants for Sheet Metal Flashings: Refer to Section 07 62 00.

F. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
   2. Verify that penetrating items are in place are properly installed.
   3. Proceeding with the work constitutes acceptance of conditions.

3.2 INSTALLATION, GENERAL

A. Build spaces, slots and recesses to accommodate items specified in this and other Sections.

3.3 FLASHING

A. General: Install embedded flashing in masonry at lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. When using peel and stick flashing, clean substrate as recommended by manufacturer, but including the following procedures:
   1. Dust and brush surfaces.
   2. Air blast surfaces after dusting.
   3. Apply primer of type recommended by manufacturer for surface in question. Where manufacturer makes no recommendation, obtain recommendation in writing from Architect.

C. 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 lintels, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
   3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Division 7 Section "Joint Sealants" for application indicated.
   4. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Division 7 Section "Joint Sealants" for application indicated.
   5. 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.
   6. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal flashing termination.

END OF SECTION

SECTION 07 71 15 - MANUFACTURED ROOF EDGES

PART 1 GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general Contract provisions, and Division 1 Specification Sections, apply to this Section.

B. Section Includes, without limitation providing: manufactured roofing edges, including.
1. Fascias.
2. Fascias commonly called “gravel stops”.
3. Copings.
4. Custom colors.

C. Related Work includes, without limitation:
1. Section 06 10 50 – Wood blocking.
2. Section 07 62 00 – Sheet metal flashing and trim.
3. Section 07 92 00 - Joint sealers
4. Division 07 00 00 – Membrane roofing

D. Extent:
1. Where shown.

1.2 SUBMITTALS

A. Product Data: Manufacturer's data, installation instructions, recommendations and restrictions.

B. Shop Drawings: Large scale shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction. Include plans, elevations, locations, profiles, joints, seams, anchorages and accessories.

C. Samples: 12 inches long, full size, with selected finish and color[s].

D. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions, and Division 01.

B. Insurance Requirements: FM approval or acceptance.

C. Warranty:
1. Copings: Lifetime of building or not less than 25 years w, category 5 wind resistance up to 215 miles per hour, no blow off, leak, or roof membrane failure due to roof edge.
2. Fascias: 20 years, up to 110 miles per hour, no blow off, leak, or roof membrane failure due to roof edge.
3. Factory finish: Comply with requirements of Section 05 08 00 – Factory applied metal coatings.

PART 2 PRODUCTS

2.1 MANUFACTURED ROOF EDGES

A. Manufactures: Subject to compliance with specifications:
1. Metal Era Inc., www.metalera.com/.
2. MM Systems Corporation, www.mmsystems.com/.

3. W.P.Hickman Co, www.wph.com/.
4. Architectural Products Co., www.archprod.com/.

B. Manufactured roof edge:
1. Basis of design: Metal-Era Perma-Tite 300 Fascia.
2. Performance: ANSI/SPRI ES-1 Standard to design pressure of 160 lbs./square foot.
3. Fascia cover material: 0.063 aluminum.
4. Concealed waterdam cleat material: Continuous G-90 galvanized steel, 24 gage.
5. Spring clips: As shown, if not, 24 gage to match waterdam cleat, spacing per manufacturer and performance criteria.
6. Corners: Factory welded, each leg 12 inch long minimum.
7. Joint detail: Concealed splice plate of matching material, finish and color behind butt joints.
8. Height: As shown, if not, 1 inch above roof, and 6 inch leg.
9. Finish: See below, using color indicated, if none, custom color.

C. Manufactured parapet coping:
1. Basis of design: Metal-Era “Perma-Tite Gold Coping”
2. Performance: ANSI/SPRI ES-1 Standard to design pressure of 290 lbs./square foot. Uplift not less than UL 1-90. Complies with Dade County “High Velocity Hurricane Zone of the Florida Building Code”.
3. Coping cover material: 0.063 formed sheet aluminum.
4. Lengths: Manufacturer standard, but not less than 120 inches.
5. Anchor/Support Cleat: 16 gauge pre-punched galvanized cleat with stainless steel spring mechanically locked to cleat; width and spacing to meet manufacturer standards and comply with performance criteria.
6. Corners: Factory welded, each leg 12 inch long minimum.
7. Joint detail: Concealed splice plate of matching material, finish and color behind butt joints. Splice plate width: Not less than 8 inches.
8. Face height and width: As shown, if not, 4 inch leg, matching wall width.
9. Finish: See below, using color indicated, if none, custom color.

D. Shop finishes: As shown, if not, Type 4 [Kynar] with custom color per Section 05 08 00 Factory applied metal finishes.

E. Joint sealants: Neutral cure silicone with +100 and -50 per cent dynamic movement range and no minimum joint size. Color to match adjacent metal as approved by Architect. Prime joints per manufacturer recommendations.

F. Fasteners: Length and type recommended by manufacturer for application; material 304 or 316 stainless steel. At fascias only, and where accepted by manufacturer and in compliance with tested assemblies, galvanized ring shank roofing nails may be used.

G. Concealed sealant tape: ASTM C1281 Preformed tape sealants for glazing applications. Use butyl glazing tape, not shimmed.

H. Scuppers: Shop fabricate and integrate into roof edge assemblies to match.
1. Segment along roof edge: 12 inches long minimum.
2. Outlet width: As shown, if not, 6 inches.
3. Projection for surface: As shown, if not, 4 inches.
4. Adjacent roof edge end closures: Required.
5. Roof membrane hold down bar: Required.
6. Drip edge: Required.

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with performance requirements, manufacturers' instructions and recommendations and the following:
1. Coordinate installation with roofing system to ensure weathertight performance.
2. Inspect substrate, blocking nailers and the like.
3. Perform pull out test to verify adequate holding capacity.

4. Anchor securely to structure to withstand inward and outward loads.
5. Isolate dissimilar metals to prevent galvanic corrosion.
6. Locate seams and joints symmetrically and uniformly.
7. Assemble work to accommodate thermal expansion and contraction.
8. Provide back up plates beneath joints.
9. Make all exposed or semi-exposed work to match exposed finishes and colors.
10. Do not damage, abrade, or harm surfaces of the work.
11. Provide a continuous waterproof seal between roof edges and exterior wall below.

B. Restore damaged finishes and surface damage so repair work is invisible or replace with new, acceptable work.

C. Clean surfaces, leave looking as new, free of any marks, prints or the like.

END OF SECTION

SECTION 07 71 23.1 - GUTTERS & DOWNSPOUTS

PART 1 GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general Contract provisions, and Division 1 Specification Sections, apply to this Section.

B. Section Includes, without limitation providing:
1. Formed or rolled aluminum gutters & downspouts.
2. Custom joints and connections.

C. Material type: Manufactured or fabricated, shaped or roll formed.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.

C. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.

D. Calculations: Submit rainfall and gutter and downspout sizing calculations.

E. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specifications, provide gutters and downspout assemblies from:
1. Gutter Supply Company; www.guttersupply.com/.
2. Riverside Sheet Metal; www.riversidesheetmetal.net/.
3. Classic Gutter Systems, LLC; www.classicgutters.com/.
4. Approved equal.

2.2 MATERIALS

A. Heavy duty gutter and downspout system:
1. Roll formed materials:
   a. Cornice temper.
   b. Thickness: As shown, if not 0.32 inch.
   c. Joints: Solvent adhesive welded. No joints permitted over doors or windows, not joints permitted in straight lengths of 30 feet or less.
2. Sizes: As shown; calculated gutter size even if size is shown on drawings and confirm dimensions with Architect before ordering. Calculate downspout size.
3. Aluminum Finish:
   a. Fluoropolymer, 3-coat, for extruded.

b. Manufacturer-applied, baked on enamel for roll formed or 2 coat kynar coil stock coating.

4. Shape: As shown. Basis of design is half round. Note that type K gutters are not an equal to half round gutters and shall not be used without the Architect's express written permission and a credit for the use of K gutters in lieu of half round.

B. Accessories: Provide the following:
1. Gutter strainers at downspout to gutter joint.
2. Concrete splash blocks at downspout terminations.

2.3 FABRICATION

A. Shop fabricate work to the greatest extent possible. Fabricate work to be truly straight, plumb, level and square, and to provide the best possible watertight, weatherproof performance with expansion provisions in running work.

B. Provide work to sizes, shapes, and profiles indicated on approved shop drawings. Comply with referenced standards. Minimize oil-canning, buckling, tool marks and other defects.

C. Make work with uniform, watertight joints. Make seams as inconspicuous as possible.

D. Isolate dissimilar materials with isolation coating or other permanent separation acceptable to the Architect.

C. Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 240 in. long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters.

D. Downspouts: Fabricate to cross section indicated, complete with mitered, welded elbows. Furnish with metal hangers and anchors, from same material as downspouts. Downspouts shall be one continuous unit without joints.

2.4 ACCESSORIES

A. Accessories: Provide the following:
1. Gutter strainers at downspout to gutter joint.
2. Concrete splash blocks at downspout terminations, not connected to catch basins or drainage system.

B. Where downspouts are intended to be connected to sub or storm drainage system, provide connecting boots where downspouts do not terminate over catch basin or gravel drainage bed. Coordinate boot type, material and connections with site work components.

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with accessory manufacturers' instructions and recommendations. Coordinate installation with roofing system to ensure weathertight performance. Anchor securely to structure to withstand inward and outward loads.

B. Isolate dissimilar metals to prevent galvanic corrosion.

END OF SECTION

SECTION 07 72 10 – SNOW GUARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Snow guards.

C. Related Sections include the following:
1. Division 7 – Steep sloped roofing sections

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, materials, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details. Indicate dimensions, plans, elevations, sections, details, and attachments to other Work.

C. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Standards: Comply with the following:
1. SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.
2. NRCA's "Roofing and Waterproofing Manual" details for installing units.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Berger Building Products Corp.
2. Sieger Snow Guards, Inc.
3. Sno-Gem, Inc.
4. Snojax, Inc.
5. Vermont Slate and Copper Services, Inc.
6. Zaleski Snow-Guard and Roofing Specialties Inc.

2.2 SNOW GUARDS

A. General: Prefabricated, noncorrosive units designed to be installed without penetrating roof and complete with predrilled holes, clamps, or hooks for anchoring. Provide guards shown, if not, as follows:
1. Plastic Type: Polycarbonate, designed for attachment to roof surface using silicone or polyurethane elastomeric sealant or adhesive tape, as recommended by manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written instructions. Coordinate installation of roof accessories and assemblies. Ensure elements are waterproof and weathertight. Anchor roof accessories securely to supporting structural substrates..

1. Snow Guards: Unless otherwise indicated, locate snow guards at 18 inches (450 mm) o.c. horizontally, and at every other course vertically, beginning 24 inches (600 mm) up from gutter. Stagger snow guard location by 9 inches (225 mm) between courses.

B. Clean exposed surfaces according to manufacturer's written instructions. Touch up damaged metal coatings.

END OF SECTION

SECTION 07 72 33 - ROOF HATCHES

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Roof hatches.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, materials, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other Work.

C. Coordination Drawings: Roof plans drawn to scale and coordinating penetrations and roof-mounted items. Show the following:
1. Size and location of work specified in this Section.
2. Method of attaching hatches to roof or building structure.
3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.

D. Samples: Manufacturer's color charts showing the full range of colors available with factory-applied color finishes.

E. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Standards: Comply with the following:
1. SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.
2. NRCA's "Roofing and Waterproofing Manual" details for installing units.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specifications:
1. Bilco Company.
2. Babcock-Davis Hatchways, Inc.
3. Nystrom Products Co.

2.2 MATERIALS, GENERAL

A. Galvanized Steel Sheet: ASTM A 653/A 653M with G90 (Z275) coating designation; commercial quality, unless otherwise indicated.

B. Insulation: Manufacturer's standard rigid or semirigid glass-fiber board of thickness indicated.

C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, complying with AWPA C2; not less than 1-1/2 inches (38 mm) thick.

D. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by manufacturer. Match finish of exposed fasteners with finish of material being fastened.

1. Where removing exterior exposed fasteners affords access to building, provide nonremovable fastener heads.

E. Accessories:
1. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.
2. Bituminous Coating: SSPC-Paint 12, solvent-type bituminous mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil (0.4-mm) dry film thickness per coating.
3. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.
4. Elastomeric Sealant: Generic type recommended by unit manufacturer that is compatible with joint surfaces; ASTM C 920, Type S, Grade NS, Class 25, and Uses NT, G, A, and, as applicable to joint substrates indicated, O.
5. Roofing Cement: ASTM D 4586, nonasbestos, fibrated asphalt cement designed for trowel application or other adhesive compatible with roofing system.

2.3 ROOF HATCHES

A. Roof & Smoke Hatches: Basis of design: Single door hatch, and LadderUp post by Bilco Co, www.bilco.com/.
1. Basis of design, subjection to meeting dimensions shown: Bilco TB, not less than size shown, but if not shown, provide 30x54 inches, thermally broken insulated cover.
   a. Basis of design, subjection to meeting dimensions shown:
      1) Unit: Bilco NB-50TB,
      2) Performance: thermally broken insulated cover with not less than 3 inches polyisocyranuate insulation with an R rating of 20.3 or better for cover and for curb.
      3) Curb: Aluminum or galvanized faced thermally broken.
      4) Weatherstripping: Integral, continuous, EPDM gasket material.
2. Access type, as shown, if not, split tread stairs.
3. Size: As shown, if not, not less than 30 x 54 inches. Verify proposed roof equipment will fit through unit as part of submittal, approval and ordering process.
4. Integrated guardrail: When shown, provide integrated guardrail equal to Bil-Guard

B. General:
1. Loading: Fabricate units to withstand external and internal loading pressure.
2. Frame with minimum 9 inch high, integral-curb, double-wall construction with insulation, formed cants and cap flashing (roofing counterflashing), with welded or sealed mechanical corner joints.
3. Lid: Double-wall cover construction with 1 inch thick insulation core.
4. Components:
   a. Resilient gasketing.
   b. Corrosion-resistant or hot-dip galvanized hardware:
      1) Pintle hinges,
      2) hold-open devices.
5. Lid lift Assistance: Compression spring operators enclosed in telescopic tubes. Automatic hold-open arm with grip handle release.
6. Performance Ratings: Complies with UL 790 Class A (burning brand test).
7. Thermal break: Required where available.
8. Finish: Factory top coating over primer and corrosion resistant material or treatment.
   a. Coatings: Baked enamel.

C. Safety equipment: Include: “LadderUP” Safety Post as follows:
1. Telescoping tubular section with automatic lock when fully extended.
2. Stainless steel spring balancing mechanism.
3. Provide fasteners for securing to ladder rungs.
4. Type: Bilco LU-2, galvanized and painted.
5. Guardrails: Provide guard rails where any part of hatch is within 120 inches of unguarded roof edge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written instructions and as follows:
1. Coordinate installation with roofing work.
2. Ensure installation is waterproof and weathertight.
3. Anchor work securely and sustain inward and outward loading pressures.
4. Install work per NRCA's "Roofing and Waterproofing Manual".
5. Separate incompatible or corrosive materials with bituminous coating or other permanent separation.
6. Flange Seals: Seal flanges to roofing.
7. Cap Flashing: Provide waterproof cap flashing to overlap with roofing or flashing and seal overlap.
8. Operational Units: Test-operate units with operable components. Clean and lubricate joints and hardware.
9. Adjust for proper operation.
10. Clean exposed surfaces according to manufacturer's written instructions.
11. Touch up damaged metal coatings.

END OF SECTION

SECTION 07 92 00 – JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Elastomeric joint sealants.
2. Preformed sealants.
3. Joint backer materials.
4. Compressible joint sealers & fillers
5. Accessories.
6. Primers, joint preparation, tooling.

C. Without limitation joints to be sealed include:
1. Perimeter assemblies.
2. Exterior and interior concrete and masonry construction
3. Penetrating or abutting elements, such as louvers, storefront, metal frames and the like.
4. Interior gaps and to provide a smooth surface for painting.
5. Bath room counters and adjacent walls, and lavatory to wall joints, toilet to floor.
6. Joints at deflection track heads in interior and exterior assemblies.

D. Related requirements:
1. Section 07 21 30 Foam gap insulation.
2. Section 07 84 00 Firestopping sealants and putties.
3. Section 07 92 21 Acoustical sealants.
4. Section 08 80 10 Exterior glass sealants.
5. Section 08 80 20 Interior glass sealants.
6. Section 09 81 10 Acoustical insulation and accessories: Acoustical sealants.
7. Division 09 00 00 Ceramic/porcelain tile: Grout joints filled with sealant.
8. Division 07 00 00 Membrane roofing.
9. Division 07 00 00 Skylights: Factory installed sealants.

E. Coordinate sealant materials with other sections or to assure required color matches.

1.2 SYSTEM DESCRIPTION

A. Materials used in fulfilling the requirements of this section shall be one of the manufacturers and the type specified for each category and shall be applied under temperatures required for each type specified in accordance with the manufacturer's recommendations.

B. Notwithstanding other requirements, specified compounds shall contain no acid or ingredients that will adversely affect masonry, metal, paint or the like.

C. Use proper materials specified herein for each location whether drawings call for "Caulking" or “Sealant".

1.3 PERFORMANCE REQUIREMENTS

A. Design sealants, including comprehensive engineering, according to the intended use, appropriate standards, and per the manufacturer’s recommendations.

B. Liquid-Applied Joint Sealants:
1. Comply with ASTM C920 and other requirements indicated for each liquid-applied joint Sealant specified, including those referencing ASTM C920 classifications for type, grade, class, and uses related to exposure and joint substrates.

2. Suitability for Immersion in Liquids: Where Sealants are indicated for use in joints that will be continuously immersed in liquids, provide products that have been tested according to ASTM C1247. Liquid used for testing Sealants is to be representative of Project conditions, unless otherwise indicated.

C. Durability Performance:
1. Use Sealant products that withstand the specified deleterious and degrading effects of radiation from the sun, weathering, atmospheric pollution, vermin, fungi, and other growths for the required service life, without maintenance in excess of routine cleaning and minor repairs.
2. Failure includes inability of the Sealant to meet the performance requirements set forth in this and all Related Sections, in addition to the following:
   a. Adhesive or cohesive failure of Sealants.
   b. Crazing on surface of Sealant.
   c. Nonstructural Sealant hardening beyond Shore A Durometer 50 or softening below Durometer 20.

D. Compatibility Performance:
1. Comply with ASTM C920 and other requirements indicated for each liquid-applied joint Sealant specified, including those referencing ASTM C920 classifications for type, grade, class, and uses related to exposure and joint substrates.
2. Suitability for Immersion in Liquids: Where Sealants are indicated for use in joints that will be continuously immersed in liquids, provide products that have been tested according to ASTM C1247. Liquid used for testing Sealants is to be representative of Project conditions, unless otherwise indicated.

1.4 SUBMITTALS

A. Comply with Division 01 General Requirements and submit for approval:
1. Product Data: Manufacturer's literature including installation instructions, use restrictions and limitations.
   a. Include handling/installation/curing instructions.
2. Samples: Color and material ranges showing variation of color and finish, if any.
   a. Initial Selection samples: Provide samples of color and material ranges.
   b. Verification: Submit final samples of selected products. Include samples showing full variation of color and finish expected.
3. Maintenance Data: Provide recommended maintenance procedures.
4. Certification: Certify submitted materials comply with requirements, and as follows:
   a. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each Sealant specified to be validated by SWRI's Sealant Validation Program.
5. Product test reports.
6. Adhesion test results.

B. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.5 QUALITY ASSURANCE

A. Comply with Division 01 requirements and governing codes and regulations.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for 5 years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

D. Use adequate numbers of skilled workmen thoroughly trained and experienced in the necessary crafts and completely familiar with the specified requirements and methods needed for proper performance of the work of this Section.

E. Applicator Qualifications: Employ only a specialty contractor with at least five years of successful experience in applying the types of sealants specified here on building projects of comparable size and complexity. The sealants applicator shall be acceptable to the sealant manufacturer and shall assume total responsibility for providing a complete sealant system. Written approval of applicator by sealant manufacturer shall accompany product data submittals.

F. Manufacturer's Field Representative: Use only sealants of manufacturers who will provide qualified field representatives to visit this Project at the beginning of sealant work to ensure proper application of the products.

G. Sealant manufacturer shall perform an ASTM C 790 Field Modified Adhesion-in-Peel test and submit documentation that cohesive failure occurs before adhesive failure, after twice rated elongation. Perform test for each sealant / substrate combination.

H. Sample Mock-ups: At the job site, at least one month prior to the scheduled beginning of sealant work, apply proposed sealants to actual joints in the presence of the manufacturer's field representative. Prior to beginning actual application work, the Architect will inspect cured sealants in the sample joints, in the presence of the Contractor and manufacturer's representative, to determine if materials and techniques were satisfactory. Written approval by the Architect shall be obtained before commencing the work.

I. Pre-installation Meeting: Conduct a pre-installation meeting at the job site simultaneous with or after field mock-ups have been prepared. Include sealant installer and his job foreman, General Contractor, manufacturer's field representative and representatives of trades affected by sealant work. Record discussion and distribute minutes to all parties.

J. Single source responsibility for joint sealants: Obtain joint sealants from single manufacturer for each different product required to ensure compatibility. Manufacturer shall instruct applicator in procedures for intersecting sealants

K. Perform work in accord with ASTM C-1193 guidelines except where more stringent requirements are indicated or specified.

L. Preconstruction compatibility and adhesion testing:
   1. Submit to joint sealant manufacturer samples of actual materials that will contact or affect their joint sealants in the Work for compatibility and adhesion testing.
   2. Use ASTM C1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint Sealants to joint substrates.
   3. With Architect's approval, testing will not be required if joint Sealant manufacturers submit joint preparation data based on previous testing, not older than twenty-four months, of Sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

M. Preconstruction field adhesion testing:
   1. In jobsite field samples prior to general installation, conduct field-tests for adhesion of joint sealants to actual joint substrates using proposed joint preparation methods recommended by manufacturer.
   2. Conduct tests for each type of sealant and substrate.
   3. Locate field-test joints where inconspicuous or as approved by Architect.
   4. Include areas typical of those requiring removal of existing sealants and utilize methods proposed for sealant removal that have been pre-approved by Architect.
   5. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in ASTM C1193, Tail Procedure, in ASTM C1521.
      a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
   6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use Sealants that fail to adhere to joint substrates during testing.
   7. Do not use joint preparation methods or sealants that produce less than satisfactory adhesion to joint substrates during testing.

N. Standard of acceptance: Joints installed during preconstruction field adhesion testing that are accepted by Architect shall be retained as standard of acceptability and incorporated into Work of that area during general installation. At least one such standard of minimum 5 feet in length shall be established for each type of sealant and substrate.

O. Schedule applications of waterproofing, water repellents and preservative finishes in coordination with sealant installation in compliance with the recommendations of the various manufacturers. Ensure that installed sealant is allowed to cure sufficiently prior to subsequent applications.

1.6 SUBSTRATE & PROJECT CONDITIONS

A. General:
1. Provide joints properly dimensioned to receive the approved sealant system.
2. Provide joint surfaces that are clean, dry, sound and free of voids, deformations, protrusions and contaminants which may inhibit application or performance of the joint sealant.
3. Where expansion joints having preformed joint fillers are scheduled to be sealed, provide a reservoir to accept the sealant such as by a molded breakaway joint cap or a removable block out.

B. Do not proceed with installation of joint Sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint Sealant manufacturer or are below 40°F.
2. When joint substrates are wet.
3. Where joint widths are less than those permitted by joint Sealant manufacturer for applications indicated. Notify Architect of condition.
4. Where contaminants capable of interfering with adhesion have not been removed from joint substrates.

1.7 WARRANTY

A. Deliver to the Architect signed copies of the following written warranties against adhesive and cohesive failure of the sealant and against infiltration of water and air through the sealed joint for a period of not less than 3 years from date of completion.
1. Manufacturer's standard warranty covering sealant materials;
2. Applicator's 2 year warranty covering workmanship.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those 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.

C. Warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants only from the following:
1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

1.8 SUSTAINABLE DESIGN

A. Notwithstanding other provisions, VOC levels for sealants shall not exceed the provisions below:

B. Exterior Applied Products: Comply with VOC limits of California Air Resources Board (ARB) 2007 Suggested Control Measure (SCM) for Architectural Coatings and South Coast Air Quality Management District SCAQMD Rule 1168 effective July 1, 2005.
1. Applicable exterior products include: Adhesives, sealants and primers. Limits are in grams per liter.

C. Interior VOC limits: Interior sealants: 250

D. Exterior VOC limits: Primers, sealants & undercoaters: 100

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Provide interior sealants and sealant primers that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
   1. Architectural Sealants: 250 g/L.
   2. Sealant Primers for Nonporous Substrates: 250 g/L.
   3. Sealant Primers for Porous Substrates: 775 g/L.

C. Colors of Exposed Joint Sealants: Provide colors as selected by the Architect from manufacturer's full range of standard and custom colors; maximum of five colors, three standard colors and two custom colors.

2.2 JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Elastomeric sealants shall be nonstaining to porous substrates. Provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

D. Single-Component Neutral-Curing Silicone Sealant:
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
      a. Dow Corning Corporation; 790 or 795.
      b. GE Silicones; SilPruf LM SCS2700.
      c. Tremco Inc.; Spectrem 1.
      d. Pecora Corporation; 864.
      e. Bondaflex Technologies; Sil 290
   2. Extent of Use: Joints in exterior vertical and soffit surfaces, including behind nail flanges, and exterior metal surfaces.

E. Multicomponent Pourable Urethane Sealant:
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
      a. Bostik Findley; Chem-Calk 550.
      b. Meadows, W. R., Inc.; POURTHANE.
      c. Pecora Corporation; Urexpan NR-200.
      d. Tremco Inc.; THC-901.
      e. Bondaflex Technologies; PUR 2 SL
   2. Extent of Use: Joints in exterior horizontal surfaces.

F. Single-Component Mildew-Resistant Acid-Curing Silicone Sealant:
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
      a. Dow Corning Corporation; 786 Mildew Resistant.
      b. GE Silicones; Sanitary SCS1700.
      c. Tremco Inc.; Tremsil 200.
      d. Bondaflex Technologies; Sil 100 WF
      e. Pecora 898NST.
   2. Extent of Use: Sanitary joints at toilet rooms.
   3. GreenGuard certification: Required.

G. Latex Sealant: Comply with ASTM C 834, Type P, Grade NF.
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
      a. Bostik Findley; Chem-Calk 600.
      b. Pecora Corporation; AC-20+.

c. Sonneborn, BASF Building Systems; Sonolac.
d. Tremco Inc.; Tremflex 834.
e. May National Bondaflex Sil-A 700

2. Extent of Use: Non-moving joints at interior locations.

H. Solvent-Release-Curing Acrylic-Based Joint Sealant: ASTM C 1311.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
a. Schnee-Morehead, Inc.; Acryl-R Acrylic Sealant.
b. Tremco Incorporated; Mono 555.
2. Extent of Use: Joints at PVC trim and panels.

I. Metal Seam Sealant:
1. Provide product designed to seal very thin metal to metal joints and to match metal color and/or finish from one of the following:
a. Protective Treatments Inc. PTI 200,
b. Tremco Tremlite Seam Sealer
c. 3M Scotch-Seal Metal Sealant or approved equal.
2. Usage: At metal to metal joints in sheet and solid stock metal assemblies, aluminum tube doors or frames, window systems, and the like.

2.3 PREFORMED JOINT SEALANTS

A. Provide precompressed expanding foam sealant with primary and secondary seal with a silicone facing backed by an expanding foam sealant in 5 standard colors and 6 special colors. Material shall be permanently elastic, mildew resistant, nonmigratory, nonstaining, and compatible with joint substrates and other joint sealants. Density and impregnating agent shall be manufacturers standard. Subject to compliance with requirements provide the following: WillSeal 600, as specified.

B. Usage: Exterior wall expansion joints. Provide width shown; if not indicated provide sealant sized for 2 inch joint.

2.4 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type B (bicellular material with a surface skin) or other type, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

D. Joint backing for general use at joints in horizontal surfaces shall be 2 rows of butyl rubber or neoprene foam rods in contact with one another and compressed to approximately 2/3 original width when in place.

E. Provide miscellaneous materials of type that will not bleed through sealant, discolor surface, or produce deleterious effects. Select size to provide profile concave to the rear of the sealant, and equipped with a bond-breaking film.

F. Applications include:
1. Cavity wall closures.
2. Where shown on drawings.
3. As required by sealant manufacturers.

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, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

D. Weep Baffle: Reticulated foam or mesh, 30 to 40 ppi. And spaced 24 in. o.c. or 6 in. from each jamb.

2.6 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor and approved by the sealant manufacturer as compatible, subject to the approval of the Architect.

2.7 JOINT DESIGN

A. Depth of joint is defined as distance from outside face of joint to closest point of joint filler, whether joint filler is rod-shaped or rectangular-shaped.

B. Joints shall not be less than 1/4" depth by 1/4" width, unless specifically approved by Architect.

C. For joints in concrete or masonry, the depth of the sealant shall be equal to width in joints up to ½" wide. For expansion and other joints exceeding ½" in width, depth of sealant shall be no greater than ½ sealant width.

D. For joints in non-porous surfaces, metal, glass, sealant depth shall be minimum of ½ sealant width, in no case exceeding sealant width.

E. Applicator shall determine that joint dimension limits noted above are met.

F. Fillet joints having 3 sided adhesion and fillet joints making use of bond breakers to prevent such adhesion will not be permitted without written approval.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the provisions of Division 01 and in particular, Section 01 70 00.

B. Install materials and systems in accordance with manufacturer's instructions, limitations and restrictions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.

3.2 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 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 all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
   2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include concrete, masonry and unglazed surfaces of ceramic tile.
   3. Remove laitance and form-release agents from concrete.

4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following metal, glass, porcelain enamel and glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.4 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type 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.
1. Do not leave gaps between ends of Sealant backings.
2. Do not stretch, twist, puncture, or tear Sealant backings.
3. Do not cut Sealant backings lengthwise.
4. Install one unit of backer rod sized according to the Project Specifications at each Sealant joint. Change backer rod sizes as frequently as required by the variation in the joint width. Do not twist rods together, fold over, or stack backer rods to fit small rods into a wider opening. Provide a full range of rod sizes at the site of all Sealant work.
5. Remove absorbent Sealant backings that have become wet before Sealant application and replace with dry materials.
6. Do not touch with fingers or otherwise contaminate the substrate surfaces while inserting the Sealant backings.
7. Do not rupture the skin of the backer rod during installation. Remove any backer rod containing punctures and solvent-clean the surfaces again.
8. Replace any backer rod not sealed over by end of each day and solvent-clean surfaces again.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. 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.
4. For weather Sealants, construct Sealant with a width-to-depth ratio of 2:1, with maximum thickness of 1/2 in. and minimum thickness of 1/4 in.
5. At fillet (triangular) joints, extend sealant at least 3/8 in. onto the surface beyond and parallel to the bond breaker (tape or backer rod) and 5/8 in. onto the surface perpendicular to the bond breaker, unless otherwise detailed or required by the manufacturer.
6. At dual-stage joints, provide a 1/4 in. deep drainage cavity between the exterior face of the secondary joint and the back-up material of the primary joint.
7. Keep sealants a minimum of 1/2 in. from asphalt-based membranes unless otherwise noted.
8. Inspect each cartridge or container of Sealant before use and verify that the production date is within six months of the date of application. Remove all Sealant more than six months old from the site.
9. Mask exposed surfaces along joint before applying Sealant.
10. Recheck correct backer rod and bond breaker tape positioning before applying Sealant.

11. Seal joints within 10 hours of primer application.
12. Within 5 min. of Sealant application and before skin develops on Sealant, dry tool the joint surface with a concave tool to ensure intimate contact with substrate and to eliminate air bubbles. Do not use any liquid for tooling. Provide a smooth, uniform, finished surface.
13. Remove masking tape within 10 min. of tooling liquid Sealant. Avoid contaminating adjacent surfaces with excess Sealant. Remove all traces of smears and droppings on metal or glass surfaces promptly, using a solvent recommended by the Sealant manufacturer and that will not damage or discolor the building surfaces. Remove smears and droppings on porous surfaces by mechanical means after the initial cure of the Sealant.
14. Coordinate work to prevent contamination of fresh Sealant by dust or other debris.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

3.5 DEFLECTION HEAD TRACK SEALING

A. At exterior and interior assemblies, provide backer rod and sealants to allow vertical movement at deflection track heads or other such assemblies. Coordinate work with other trades such as sheathing assemblies and air barrier assemblies installation.

3.6 CURING & PROTECTION

A. Cure sealants in compliance with manufacturer’s instructions and recommendations to obtain optimum surface quality and maximum adhesion. Make every effort to minimize accelerated aging effects and increase in modulus of elasticity.

B. Protect joint sealants from contact with contaminating substances and from damages. Cut out, remove and replace contaminated or damaged sealants, immediately, so that they are without contamination or damage at time of substantial completion.

3.7 FIELD QUALITY CONTROL

A. Provide necessary supervision of sealant installation to ensure proper preparation, application and compliance with requirements.

B. Replace deficient or rejected work at no cost to Owner and to avoid job delays.

C. Ensure sealant manufacturer technical representative visits job site at a minimum of once every two weeks to inspect workmanship and materials quality, and verifies sealant joints are installed according to manufacturer's requirements and recommendations.

D. Test exterior sealant joints per Test joint Sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in ASTM C1193, Tail Procedure, in ASTM C1521. This is a destructive testing procedure.
1. Perform test after a minimum of twenty-one days after sealant installation.
2. Patch test areas in accordance with Manufacturer's instructions. If application is not acceptable, conduct additional test as directed.
3. Number of tests: Test at rate of 1 test per 100 linear feet installed sealant for first 1,000 ft of joints. If no test failure is observed in first 1,000 linear feet, perform 1 test per 1,000 linear thereafter, or once per floor per elevation.
4. Acceptability criteria: Sealant should fail cohesively (within itself) with no adhesion (aka: debonding) failure at an elongation of more than twice stated movement capability of sealant. Unacceptable applications result in cohesive failure when elongated to less than twice stated movement capability or for any adhesion failure.

E. Inspect tested joints and report whether joints are:
1. Sealant-filled joint cavities and free of voids.

2. Dimensions and configurations comply with specified requirements.
3. Connected to pulled-out portion failed to adhere to joint substrates or tore cohesively.
4. And Include data on pull distance used to test each kind of product and joint substrate.
5. Compare these results to determine if adhesion passes Sealant manufacturer's field-adhesion hand-pull test criteria.

F. Record test results in a field-adhesion-test log. Include dates when Sealants were installed, names of persons who installed Sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, Sealant fill, Sealant configuration, and Sealant dimensions.

G. Repair Sealants pulled from test area by applying new Sealants following same procedures used originally to seal joints. Ensure that original Sealant surfaces are clean and that new Sealant contacts original Sealant.

H. Evaluation of Field-Adhesion Test Results:
1. Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory.
2. Remove Sealants that fail to adhere to joint substrates during testing or to comply with other requirements.
3. Retest failed applications until test results prove Sealants comply with indicated requirements. For every failure, perform two additional tests.

3.8 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.9 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.
1. Adjust components or connecting hardware in accordance with manufacturer's instructions.
2. Remove temporary coverings and protection of adjacent work areas.
3. Clean installed products in accordance with manufacturer's instructions before owner's acceptance.
4. Remove from project site and legally dispose of construction debris associated with this work
5. Protect installed products until completion of project.
6. Repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 07 92 11 - JOINT SEALING FOR RADON GAS PREVENTION

PART 1 GENERAL

1.1 SUMMARY

A. Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section Includes, without limitation providing:
1. Joint sealers to prevent dispersal of radon gas.
2. Joint fillers.

C. Extent:
1. Where shown.
2. Cracks and penetrations of slabs-on-grade and below grade walls.

1.2 SUBMITTALS

A. Comply with Section 07 92 00.

1.3 QUALITY ASSURANCE

A. Comply with Section 07 92 00.

PART 2 PRODUCTS

2.1 MATERIALS

A. Comply with requirements of Section 07 92 00.

PART 3 EXECUTION

3.1 GENERAL

A. Comply with Section 07 92 00.

3.2 INSTALLATION

A. Examine substrate; report unsatisfactory conditions in writing. Beginning work means acceptance of conditions.

B. Provide sealants to prevent sub-slab and sub-grade gases from escaping into occupied spaces. Include sealing:
1. Penetrations in slab on grade and below grade foundation walls.
2. Construction joints.
3. Expansion joints.
4. Top of compressible fillers at slab to wall joint.

END OF SECTION

SECTION 08 11 10 - STEEL DOORS & FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 specification sections, apply to this Section.

B. Section Includes, without limitation, providing:
1. Steel doors and frames.

C. Related requirements includes, without limitation:
1. Section 06 46 00 - Interior Wood Trim.
2. Section 08 14 16 - Flush wood doors.
3. Section 08 71 00 - Door Hardware.
4. Section 09 10 50 - Metal blocking.
5. Division 09 - Painting.

1.2 DEFINITIONS

A. Steel doors and frames shall refer to carbon steel, conventionally called “hollow metal”, expect provide stainless steel if specified below or indicated on drawings.

1.3 REFERENCE STANDARDS

A. Provide assemblies complying with indicated standards including:
1. ASTM B209 Specification for aluminum & aluminum alloy sheet & plate.
2. ASTM A666 Specification for annealed or cold-worked austenitic stainless steel.
3. ASTM A1008, Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
4. ASTM A568, Specification for Steel Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements.

1.4 SUBMITTALS

A. Comply with Division 1 General Requirements and submit for approval:
1. Product Data: Manufacturer’s literature including preparations, installation instructions, use restrictions and limitations.
2. Shop drawings: Large scale drawings for fabrication, installation and erections including plans, elevations, details, anchorages, connections and accessories along with head, jamb, sill and joining details. Provide templates for work installed by others.
    a. Show hardware locations, cuts, reinforcing plates, fillers, and finishes.
    b. Field Measurements: Take accurate field measurements before fabrication and indicate same on shop drawings.
3. Test reports: Provide results from actual UL listing.
4. Maintenance Data: Provide recommended maintenance procedures.
5. Certification: Certify submitted materials comply with requirements.

B. Product Test Reports: Submit manufacturer’s certified UL lab test reports not more than 5 years old documenting product performance and provide copies of current UL listing.

C. Sustainability [LEED] Submittals: Comply with of Division 01 and submit:
1. Documentation from manufacturer for LEED requirements for materials and products.
2. Information on required forms.

1.5 PERFORMANCE

A. Provide assemblies that are non-ricochet types, using materials complying with UL 752.

1.6 QUALITY ASSURANCE

A. Comply with the following:
1. Source Limitations: Obtain materials of uniform quality from single manufacturer.
2. Qualifications: Not less 5 years experience in manufacturer of specified products.
3. SDI requirements: Steel Door Institute "Recommended Specifications for Standard Steel Doors and Frames" (SDI 100), except as otherwise specified here.
4. Fire-Rated Assemblies: Where shown or required, provide fire-rated doors UL or WH label[s]. as a fire door assembly, complete with type of hardware to be used. Identify each fire door assembly with labels indicating applicable fire rating of steel door. Construct and install assemblies to comply with label requirements and NFPA Standard No. 80.
5. Templates: Secure templates from hardware supplier before fabricating doors and frames.

1.7 PRODUCT REQUIREMENTS

A. Comply with Division 1 and the following:
1. Carton or crate to provide protection during transit and job storage.
2. Where applicable ship frames with removable angle spreaders securely fastened to bottom of each jamb; do not remove until frames are secured in place.
3. Cover assemblies to prevent rust and damage.
4. Store doors and frames vertically, inside, on 4 inch high dunnage.
5. Ensure UL labels remain intact and legible.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Acceptable manufacturers and fabricators include:
1. Amweld Building Products;
2. Ceco Door Products; Curries Co.;
3. Mesker Door;
4. Steelcraft Manufacturing.
5. Approved equal.

2.2 MATERIALS

A. Sheet Steel - Comply with the following:
1. General: Free from scale, pitting or other defects; stretcher leveled for doors.
2. Non-galvanized: Cold rolled meeting ASTM A1008 [High strength].
3. Galvanized: Hot rolled steel meeting ASTM A568 and A569.

B. Zinc coating for steel: Hot dip galvanizing complying with ASTM A924-94, Coating Designation G60 (a coating weight of not less than 0.30 ounces per square foot per side for 0.60 total), phosphatized; stretcher leveled for doors.

C. Where special order or work is required to provide acceptable finish for painting G60 surface, provide same. Wipe coats (WCGS) are not an acceptable substitute for G60.

D. Reinforcement Steel: ASTM A36.

E. Filler: Sound deadening and heat-retarding mineral fiber insulating material, 2000 degree F melt point, for door cores.

F. Inserts and Fasteners: Manufacturer's standard units except hot-dip galvanized items to be built into exterior walls to ASTM A-153 standards, Class C or D as applicable.

G. Shop painting: Provide shop Primer, baked-on, and either, metallic oxide, zinc chromate or synthetic high performance resin primer.

H. Field painting: Division 09.

2.3 EXTERIOR DOORS

A. Exterior Doors – Comply with ANSI A250.8 and the following:

1. Thickness: As shown, if not - 1-3/4".
2. Grade: 3, Extra Heavy Duty [Endurance Level A]
3. Model: 2, Seamless, fully welded, metal seam filler only.
4. Gage: As given below.
5. Finish: Galvanized, and shop primed.

B. Steel door panels shall be fabricated from one sheet of hot-rolled steel. Doors shall be flush with invisible edge seams, and shall have vertical mechanical interlocking seams on hinge and lock edges, and provided with 14-gage top and bottom inverted steel channels spot welded within the door.

C. Doors shall be insulated with polyurethane or other approved insulation, either foamed in place or laminated to each panel. Compressive strength of the polyurethane shall be a minimum of 20 psi. Strength of the bond between the polyurethane and the steel face panels shall exceed the strength of the polyurethane, so that delamination does not occur under any operating conditions. Voids in foam shall not exceed 1/2" in any direction. Foam density shall not be less than 1.8 pounds per cubic foot with a U value as specified below.

D. Provide outswinging doors with galvanized steel or rigid vinyl top caps, set flat side up, closed, sealed and waterproof.

E. Provide thermally improved doors with maximum U-value of BTU/hr./square foot degree Ffor all exterior doors and elsewhere as noted, as follows for flush doors:
1. Per ASTM C518: 0.10
2. Per ASTM C1363: 0.39

2.4 INTERIOR STEEL DOORS

A. Interior Doors – Comply with ANSI A250.8 and the following:
1. Thickness: As shown, if not - 1-3/4".
2. Grade: 2, Heavy Duty [Endurance Level B]
3. Model: 2, Seamless, fully welded, metal seam filler only.
4. Gage: As given below.
5. Finish: Sop primed. Indicated doors and doors associated with water or pump or mechanical equipment shall also be hot dipped galvanized.

B. Steel door panels shall be fabricated from one sheet of cold rolled steel (except of any interior doors indicated to be galvanized, provide hot rolled steel.). Doors shall be flush with invisible edge seams, and shall have vertical mechanical interlocking seams on hinge and lock edges. Doors shall be provided with 14-gage top and bottom inverted steel channels spotwelded within the door.

C. Doors shall be reinforced, stiffened, and sound deadened with impregnated kraft honeycomb core completely filling the inside of the door and laminated to the inside faces of the panels. Honeycomb material shall have a crushing strength of not less than 4,000 pounds per square foot and the lamination shall stand not less than 1,100 pounds per square foot in shear.

2.5 STEEL FRAMES

A. Furnish and install pressed steel combination buck and trim type frames for doors and other partition frame construction.

B. Fabricate exterior frames in accordance with SDI-111A, ANSI 250.8 , and the following:
1. Frames type[s]: Welded.
2. Corner construction/welded: Continuous full factory weld, seamless including face, rabbet, stop, and soffit.
3. Gage: 16 gage or heavier.
4. Profile: Double rabbet unless otherwise shown.
5. Corrosion coatings: Galvanized and shop primed as specified.
6. Provide thermal break frames equal to Ceco Doors Products Thermal Break Mercury Thermal Break Steel Frames

C. Fabricate interior frames in accordance with SDI-111A, ANSI 250.8 , and the following:
1. Frames type[s] usage:
   a. Welded: All frames. Where shown and at a minimum as follows:

2. Corner construction/welded: Continuous full factory weld, seamless including face, rabbet, stop, and soffit.
3. Corner construction/knocked down: Not required.
4. Fasteners: Not permitted in face frame; acceptable at centerline of door stop to secure anchor clip with flat head, counter sunk fastener.
5. Gage: As given below.
6. Typical corrosion coatings: Shop primed as specified. Indicated doors and doors associated with water or pump or mechanical equipment shall also be hot dipped galvanized.
7. Basement level corrosion coatings: Hot dipped galvanized and shop primed as specified.
8. Fire ratings: Required; per door schedule.

D. Anchors: Comply with the following:
1. Quantity: Minimum 3 anchors per jamb.
2. Jambs over 8'-0" in height: 1 additional anchor for each 2'-0" or fraction thereof.
3. Construction: 18-gage steel strap or 3/16" diameter wire, adjustable or "T" shaped.
4. Existing openings: Manufacturer's standard pipe sleeve or spreader anchor device.
5. Floor anchors: Welded inside each jamb. Up to 2 inch adjustable permitted subject to compliance with standards.

E. Silencers: Drill stops to receive three silencers on strike jamb of single swing frames and two silencers on heads of double swing frames.

F. Weather-stripped frames: Provide where indicated; silencers not required.

G. Plaster Guards: Provide 26 gage steel plaster guards or mortar boxes, welded to frame, at back of finish hardware cutouts where mortar or other materials might obstruct hardware operation and to close off interior openings.

H. Wide Openings: Reinforce frames wider than 48 inches with roll formed steel channels fitted tightly into frame head, flush with top.

2.6 LABELED DOORS AND FRAMES

A. Labeled doors and frames:
1. Usage: For openings requiring fire protection ratings.
2. Labels: Provide doors and frames with fire labels to match ratings of wall opening assemblies.
3. Label type: Metal identification permanently attached. Do not paint over labels.
4. Acceptable fire tests: ASTM E-152 and UL-10B. [Positive pressure: UL10C]
5. Temperature Rate of Rise performance: At rated stairs and where required by reference standards.

B. Comply with the following:
1. Advise Architect in writing before fabricating work where door or frame assembly cannot qualify for appropriate fire labeling due to design, hardware or other reason.
2. Provide an overlapping metal astragal on pairs of doors. Where astragals are prohibited by code, provide fire rated units without astragals in accordance with NFPA-80.
3. Provide automatic louvers for Where fire doors are indicted with louvers, provide automatic fire closure type.

2.7 SHOP FINISHING

A. Finish doors and frames by completely cleaning with a degreaser, bonderizing and applying one coat of baked-on metallic oxide, zinc chromate or synthetic resin primer in a light gray color, 1.25 mils thickness - which, in the case of exterior and indicated doors, will be over galvanizing.

2.8 STEEL GAGES

A. Except where heavier gages are required by referenced standards or are specified, provide doors and frames of the following minimum gages:

Item	**Gage**
Exterior Doors	16
Exterior Door Frames	14
Interior Doors	18
Interior Door Frames	16
Removable Door Stops	11

Adjustable Jamb Anchors 8
Clip Angles at Bottom of
Door Jamb 14
Inverted channel, top & bott. . 14
Structural Reinforcing 10
Floor Anchors. 14

2.9 GLASS

A. Factory glaze doors using tempered glass, of thickness shown, if not, 0.25 inch thick. For exterior doors provide 5/8 inch thick tembered glass insulated units with argon fill and low E coating on number 2 surface.

2.10 STEEL FABRICATION - GENERAL

A. Comply with the following:
1. Execute fitting, fabricating of work at shop; ship work ready for erection at building.
2. Fabricate steel door and frame units to be rigid, neat in appearance and free from blemishes, warp or buckle.
3. Accurately form metal to required sizes and profiles.
4. Wherever practicable, fit and assemble units in the manufacturer's plant.
5. Identify work that cannot be permanently factory-assembled before shipment, to assure proper assembly at the project site.
6. Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from stretcher-leveled cold-rolled steel, ASTM A-366.
7. Fabricate frames, concealed stiffeners, reinforcement, edge channels, louvers and moldings from either cold-rolled or hot-rolled steel at fabricator's option; use hot rolled for galvanized sheets.
8. Fabricate exterior doors, internal stiffeners, panels and frames from galvanized sheet steel complying with standards referenced above.
9. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat Phillips heads for exposed screws and bolts.
10. Finish Hardware Preparation: Prepare hollow metal units to receive mortised and concealed finish hardware, including cutouts, reinforcing drilling and tapping in accordance with final Finish Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A115 "Specifications for Door and Frame Preparation."
11. Reinforce hollow metal units to receive surface-applied hardware. Drilling and tapping for surface-applied finish hardware shall be done at project site.
12. Locate finish hardware as shown on final shop drawings, or if not shown, in accordance with "Recommended Locations for Builder's Hardware", published by the National Builder's Hardware Association.
13. Thermal-Rated (Insulating) Assemblies: At exterior locations and elsewhere as shown or scheduled, provide doors which have been fabricated as thermal insulating door and frame assemblies and tested in accordance with ASTM C 236. Unless otherwise indicated max. apparent U factor for thermal-rated assemblies is 0.24 BTU/hr/sf/degree F.
14. Shop Painting: Clean steel surfaces of mill scale, rust, oil, grease, dirt and other foreign materials before the application of the shop coat of paint. Apply shop coat of prime paint of even consistency to provide a uniformly finished surface ready to receive field-applied paint. Both galvanized and ungalvanized steel shall be shop primed.

2.11 DESIGN CLEARANCES

A. Comply with requirements of SDI and the following. In the event of conflict, use the more stringent clearance:
1. Between door and frame: 1/8" maximum, single and double leaf.
2. Meeting edges: 3/16" ± 1/16" at pair of doors.
3. Meeting edges/fire doors: 1/8" ± 1/16" at pairs.
4. Undercut door bottom to frame: 3/4" maximum unless otherwise specified.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the provisions of Section 01 70 00.

3.2 EXAMINATION

A. Examine and verify conditions per Section 01 70 0 and as follows:
1. Verify substrates and underlying work is within tolerances specified.
2. Verify structural components are properly placed.
3. Before installation, examine rough-in and built-in construction for mechanical/electrical and other systems to verify actual locations of connections.
4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION OF HOLLOW METAL WORK

A. General: Install hollow metal units and accessories in accordance with final shop drawings and manufacturer's data, and as herein specified.

B. Placing Frames:
1. Comply with provisions of the following unless otherwise indicated:
a. Steel Door Institute publication #105
b. SDI 122.
c. ANSI A250.8 and A250.11.
2. Place welded frame prior to construction of enclosing walls and ceilings.
3. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set.
4. Level frames throughout each visually continuous area.
5. Conceal anchors.
6. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.
7. Install fire-rated frames in accordance with NFPA Standard No. 80.
8. Allow for expansion movement as required.

C. Frames at acoustically or thermally rated doors: Fill frame voids with compressed rock mineral wool fiber. Seal door frame to wall at entire perimeter both sides.

D. Hang hollow metal doors and fit hardware.

E. Thermal bow: Replace doors with thermal bow, whether permanent, temporary or intermittent and where doors do not operate normally, do not latch, do not have tight seal at head, jamb or sill.

F. Final adjustments: Check and readjust operating finish hardware items in hollow metal work just prior to final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including doors or frames which are warped, bowed or otherwise damaged.

3.4 INSTALLATION OF FINISH HARDWARE

A. Hardware shall be attached and placed by skilled mechanics and shall be accurately fitted and adjusted. Install door pulls, latchsets, locksets, etc. at locations as drawn or conforming to National Association of Hardware Manufacturer's standards. Install hardware after doors have been finish painted.

B. Protect hardware against damage until substantial completion of the project using cloth or paper covering.

C. Install all metal thresholds furnished as part of the finish hardware in accordance with manufacturer's printed recommendations. Set exterior thresholds in beds of sealant.

D. Final Adjustments: Check and readjust operating finish hardware items in hollow metal

3.5 CLEAN UP & PROTECTION

A. Comply with Section 01 70 00.

B. Maintain doors until final acceptable per SDI-124, *Maintenance of Standard Steel Doors and Frames*.

END OF SECTION

SECTION 08 12 22 – INTERIOR ALUMINUM DOORS, FRAMES & SIDELIGHTS

PART 1 GENERAL

1.1 SUMMARY

A. Related Documents: All Contract Documents and provisions, including Drawings, and Division 1 General Requirements apply to this Section.

B. Section includes, without limitation, providing interior aluminum:
1. Frames.
2. Doors with glass lites.
3. Storefronts and sidelights
4. Reinforcements, anchors, and accessories.
5. Shop finishes.
6. Installation of door hardware.
7. Special door/frame sizes and heights.

C. Related work includes, without limitation:
1. Section 08 14 16 - Flush wood doors.
2. Section 08 71 00 - Door Hardware
3. Section 08 80 20 - Interior Glass
4. Division 08 - Glass and Glazing: Glazing into hollow metal doors.

1.2 SUBMITTALS

A. Comply with Division 1 General Requirements and submit for approval:
1. Product Data: Manufacturer's literature including installation instructions, use restrictions and limitations. Include full line of products, data for factory finishes, glazing gaskets, accessories, color charts and aluminum construction details.
2. Shop drawings: Large scale drawings for fabrication, installation and erections including plans, elevations, details, anchorages, connections and accessories along with head, jamb, sill and joining details. Provide templates for work installed by others.
    a. Field Measurements: Take accurate field measurements before fabrication and indicate same on shop drawings.
    b. Materials: Indicate gauges, hardware location reinforcement, cutouts, anchors installation details and finishes.
    c. Door Schedule: Submit complete schedule of doors and frames calling out each individual opening and giving mark, hand, location, size, type and other information. Leave a blank space for Architect's review comments and revisions on the schedule between each door and frame listed.
3. Initial Selection samples: Provide samples of color and material ranges.
4. Verification: Submit final samples of selected products. Include samples showing full variation of color and finish expected.
5. Maintenance Data: Provide recommended maintenance procedures, care and handling.
6. Certification: Certify submitted materials comply with requirements.

B. Mock-Up/Field Samples: Prior to installation, provide mock up of each type of system proposed for use for approval. Accepted mock-ups may be incorporated into the work unless otherwise noted.

C. Product Test Reports: Submit manufacturer's certified independent lab test reports not more than 2 years old documenting product performance.

D. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.2 QUALITY ASSURANCE

A. Provide frames manufactured by a single firm specializing in the production of this type of work, unless otherwise acceptable to the Architect.

B. Provide aluminum complying with ASTM B221 “Specifications for Aluminum-Alloy Extruded bars, Rods, Wires & Shapes”. Provide finishes complying with applicable Architectural Aluminum Manufacturer’s Association requirements.

C. Templates: Secure templates from hardware supplier before fabrication.

1.3 PRODUCT DELIVERY AND STORAGE

A. Deliver metal work cartoned or crated to provide protection during transit and job storage. Provide banding, buffers, spreaders, separators, shrink wrap and the like as necessary to prevent damage; until frames are secured in place, remove only such protective as absolutely essential for installation.

B. Inspect metal work upon delivery for damage. Minor damage may be repaired provided the refinished items are equal in all respects to new work and acceptable to the Architect; otherwise, remove and replace damaged items.

C. Store doors and frames at the building site upright and under cover. Place the units on wood dunnage and cover in a manner that will prevent rust and damage.

1.4 WARRANTY

A. Provide manufacturer’s standard warranties against manufacturing defects, but in no case less than 2 years from date of substantial completion.

B. Warrant aluminum finish against defects including cracking, flaking, blistering, peeling and excessive fading, chalking and non-uniformity for a period of 5 years.

C. Warrant aluminum and glass doors for life of door against corner construction failure.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with specifications provide assemblies and product series by one of the following:
Kawneer Company Inc of Norcross GA
Raco Interior Products
Frameworks Manufacturing Inc of Houston TX
Wilson Partitions of Vernon CA.
SpaceWorks of Boston MA (S487 Frames Series)

B. Basis of design: Raco Interior products.

C. Acceptable product series:
1. Interior door frames: RACO Classic fixed frames to accommodate indicated wall thickness and assembly heights. Sightline or width of frame shall be 1-1/2 inches.
2. Interior aluminum storefronts and borrowed lights: Raco Classic fixed throat frames of indicated thickness, lights and layout with 1-1/2 inch frame sightline face.
3. Interior wood doors: See Wood door section, in Division 08.
4. Interior aluminum doors: RACO 550 wide stile doors with square glazing stops, EPDM glazing gaskets and ADA compliant bottom rails.

5. Prepare for hardware provided under the requirements of Section 08 71 00 and in compliance with Owner's standards including the following:
   a. 4.5x4.5 inch ball bearing butts, not less than 1.4 pair.
   b. Latch/lockset or push/pulls.
   c. Closers.

D. Manual sliding doors assembly: Acceptable product: Raco Sliding Innovations Solutions II Flush Frame or Offset Frame or Classic Offset Frame as shown on details.
1. Mounting: Top hung.
2. Bottom threshold: No.

2.2 MATERIALS

A. Aluminum: Extrude components from controlled alloy billets of 6063 T5 or 6463 T5 complying with ASTM B 221 not less than 0.125 inch thick except for glazing beads.

B. Inserts and Fasteners: Provide fasteners of aluminum, stainless steel, or zinc plated steel or other non corrosive materials which are compatible with aluminum components, hardware and anchors in accordance with ASTM A 164.

C. Provide backboxes at strike plates.

2.3 FABRICATION, GENERAL

A. Fabricate units to be rigid, neat in appearance and free from blemishes, warp or buckle. Accurately form metal to required sizes and profiles. Wherever practicable, fit and assemble units in the manufacturer's plant. Clearly identify work that cannot be permanently factory-assembled before shipment, to assure proper assembly at the project site.

B. Exposed Fasteners: Use of exposed fasteners is strongly discouraged. Where no practical alternative exists and unless otherwise indicated, provide countersunk flat Phillips heads for exposed screws and bolts.

C. Finish Hardware Preparation: Prepare metal units to receive mortised and concealed finish hardware, including cutouts, reinforcing drilling and tapping in accordance with final Finish Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A115 "Specifications for Door and Frame Preparation."

D. Reinforce metal units to receive surface-applied hardware. Drilling and tapping for surface-applied finish hardware shall be done at project site.

E. Locate finish hardware as shown on final shop drawings, or if not shown, in accordance with "Recommended Locations for Builder's Hardware", published by the National Builder's Hardware Association.

2.4 ALUMINUM FRAME FABRICATION

A. Unless other wise noted, fabricate units knocked down for field assembly.

B. Main frame member thickness: Extruded aluminum not less than 0.062 inch nominal, increase to 0.130 inch at frame and hinge anchorage.

C. Design and fabricate frames to permit installation over pre-finished walls.

D. Provide adaptors and break metal as required to complete assemblies. On less otherwise indicated, breakmetal shall be match material and finish and use 0.125 inch thick material.

E. Provide continuous EPDM, neoprene or , nylon backed wool pile sound and light seal around perimeter door stop.

F. Unless other wise shown, or custom casing is indicated, provide 1-1/2 inch standard profile with 7/16 inch wall standoff.

G. Glazing frames: Provide snap-in type stops with neoprene gaskets. Do not permit glass adjacent to metal without intervening gasket. Reinforce door jambs having integral glazing with channel stiffener. Intermediate mullions shall maintain selected profile and unless other wise indicated shall be 1.5 inches.

2.5 SHOP FINISHES & COLORS

A. Concealed steel items shall be galvanized per ASTM A 123 with 2.0 ounces per square foot.

B. Specified aluminum components shall be free of scratches or other serious blemishes and receive a caustic etch followed by an anodic oxide treatment.

C. Anodized Finish – Finish option 1: Exposed surfaces with the indicated Architectural Class coating in accordance with AAMA 611 Architectural Grade anodic coating, fully sealed and free of powdery surfaces. Coating shall conform to minimum requirements for thickness and weight of ASTM B 137.

Class I anodic finish type A41/A42/44: Minimum coating as follows:
0.7 mils Thickness
27.0 mg/in^2 Weight
38.0 g/in^3 Apparent Density

D. Factory Applied Paint Finish – Finish option 2 - : Comply with AAMA 2603 and AA-DAF-45, factory applied baked enamel coating.

E. Where Architect does not indicate finishes or options, use Option 1.

F. Color: Provide color as selected by Architect.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that wall surfaces to receive work are smooth, flat, and of proper size.

3.2 INSTALLATION

A. General: Install units and accessories in accordance with final shop drawings and manufacturer's data, and as specified.

B. Placing Frames:
1. Securely anchor to partitions, with fasteners of the type recommended by manufacturer.
2. Place preassembled frames prior to construction of enclosing walls and ceilings.
3. Set frames accurately in position, plumbed, plane, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.
4. Install fire-rated frames in accordance with NFPA Standard No. 80.
5. Allow for expansion movement as required.

C. Ensure doors are properly hung and hardware properly fit, whether provided under this or another section.

D. Install glass and glazing per manufacturer’s requirements and under requirements of Section 08 80 20.

E. Final adjustments: Check and readjust operating finish hardware items in work just prior to final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including doors or frames which are warped, bowed or otherwise damaged.

3.3 CLEAN UP & PROTECTION

A. Remove all debris resulting from the work of this Section from the job site and legally dispose of it.

B. Clean all smudges, fingerprints and soil from work prior to presenting work for acceptance. Clean work in compliance with AAMA 609.1-1985 " Voluntary Guide Specifications for Cleaning and Maintenance of Anodized Aluminum."

C. Restore or replace adjoining work damaged or soiled by the work of this Section.

D. Protect work until final acceptance from any and all damage.

END OF SECTION

SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing: Flush wood doors.

1.2 SUBMITTALS

A. Comply with Division 01 and the following:
1. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
2. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.

B. Warranty: Submit manufacturer's standard warranty. Include labor and materials to repair or replace defective materials.
1. Solid-Core Exterior Doors: 5 years.
2. Solid-Core Interior Doors: Life of installation.

C. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Quality Standards for Stile and Rail Doors: NWWDA I.S. 6.

C. Quality Standards: [NWWDA I.S.1-A, "Architectural Wood Flush Doors."] [AWI's "Architectural Woodwork Quality Standards Illustrated."].

D. Quality Standards: [NWWDA I.S.1-A, "Architectural Wood Flush Doors."] [WI's "Manual of Millwork."]

E. Fire Rated Wood Doors: Meet NFPA 80 requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide flush wood doors by one of the following:
1. Masonite Architectural
2. Eggers Industries; Architectural Door Division
3. VT Industries

2.2 DOORS FOR TRANSPARENT FINISH

A. Comply with the following requirements:
1. Grade: AWI Premium, with Grade AA faces.
2. AWI Construction: PC5.
3. Core: ANSI 208.1, LD2, 32 pound density particle board or heavier.
   a. No added urea formaldehyde resin type [NAUF] required: Yes.
4. Stiles & Rails: Required, bonded to core. Sand entire assembly before cross banding.
5. Adhesives: Type 1, waterproof.

6. Door face / Veneer species: As shown, if not, Maple, hard “select white” (sapwood), flat sliced quarter sawn.
7. Veneer construction: For transparent finish at least 1/50 after sanding inch thick wood veneer sheet adhered to 1/16 inch hardwood cross band backing and adhered to core, rail and stile by hot-press method, quarter sawn.
8. Stiles Edges: Applied wood edges of same species as faces and covering edges of faces.
9. Top edge: Where visible, match face; where not, seal with applied coatings to match face.
10. Match between Veneer Leaves: Vertical, slip match.
11. Pair and door matching: Pair and set match, continuous sequence for bi-folds.
12. Fire ratings and holding capacity: See below.

2.3 BLOCKING & CORE CAPACITY

A. Comply with the following:
1. Screw withdrawal minimums: Face – 700 lbs.; Edge – 400 lbf.
2. Blocking: Required.
3. Blocking Material: Composite lumber core laminated construction for screw holding capacity and split resistance.
4. Usage: To include - hinge stiles, locks, latches, closers, armor plates, exit devices, kicks & the like.

B. Large glass lites: For flush doors with large glass lites, provide special door core construction to provide cut-outs and sizes indicated without lite/lock conflicts or invalidating door warranty.

2.4 FIRE-RATED DOOR REQUIREMENTS

A. Comply with the following:
1. Match non-fire rated doors, unless otherwise indicated.
2. Fire resistance ratings: As schedule, but at least equal to partition in which door is located.
3. Faces: Veneered composite to maintain fire rating.
4. Labels: UL, W/H or other approved nationally recognized laveling and testing agencies. Do not remove or obscure labels.
5. Prefitting: See below.
6. Core: Manufacturer's standard mineral-core construction as required for fire rating indicated and equal to ANSI A208.1, Algoma Weldrok core.
7. Blocking & Hinge attachment: Equal to Algoma “Superfire System.”
8. Through bolting hardware: Not permitted; use blocking not requiring same.

2.5 GLAZING FRAMES / MOLDINGS / LOUVERS

A. Comply with the following:
1. Material: Wood for non-fire rated doors; Veneered composite to maintain rating for fire doors.
2. Appearance: Match door in every respect.
3. Profile, style: As shown, if not: square, flush glazing.
4. Seams or joints: Only at corners.
5. Corners: As shown, if not shown, mitered, tight hair line.
6. Fasteners: Counter sunk flush where required to exposed; set and puttied where not, of non-corrosive material and finish.

B. Glazing: Provide loose stops for glazing as required for use under Section 08800 Glass & Glazing.

C. Louvers: As shown, if not, not required.

D. Astragals: Provide at double doors.

E. Face applied moldings: Match profiles shown. If not shown, not required.

1.2 FACTORY FINISHING

A. General: Comply with AWI “Architectural Woodwork Quality Standards Illustrated” for factory finishing.

B. Doors to receive finish at factory.

C. Transparent Finish: Comply with requirements indicated for grade, finish system, staining effect, and sheen.
   1. Grade: Premium.
   2. Finish: Manufacturer's standard low VOC or water-based finish with a performance score of 100 or better. If manufacturer lacks a standard, use ASW System 9 or aka, TR-9.
   3. Effect: Smooth, lustrous, grain-free finish.
   4. Sheen: As selected by Architect, but including satin.

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with NWMA I.S. 1A and specified quality standard.

B. Prefit doors to frames. Premachine doors for hardware listed on final schedules. Factory bevel doors.

C. Install doors with not more than 1/8 inch clearance at top and sides, 1/4 inch at bottom. Comply with NFPA 80 for rated assemblies.

D. Adjust, clean, and protect.

END OF SECTION

SECTION 08 31 50 – ACCESS DOORS & PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section Includes, without limitation, providing:
1. Access panels and doors.
2. Fire rated components.
3. Shop finishes.

C. Extent, without limitation, includes: As shown and including access components in walls and ceilings for chases, valves, controls and equipment.

D. Related Sections, without limitation, include:
1. Section 09 29 00 - Gypsum board.

1.2 REFERENCES, STANDARDS & CODES

A. All references to codes, specifications and standards referred to herein shall become a part of this section as though written out, and shall mean, and is intended to be the latest edition, amendment, and/or revision of such reference unless otherwise specified.
1. UL - Underwriters' Laboratories, Inc.

1.3 SUBMITTALS

A. Comply with Division 01 General Requirements and submit for approval:
1. Product Data: Manufacturer's literature including installation instructions, use restrictions and limitations.
2. Shop drawings: Show details of adjacent construction, pertinent dimensioning, component connections and locations, anchorage methods and locations, and installation details including rough-in dimensions for access panels indicated.. Provide templates for work installed by others.
   a. Field Measurements: Take accurate field measurements before fabrication and indicate same on shop drawings.
3. Samples: Color and material ranges showing variation of color and finish, if any.
4. Certification: Certify submitted materials comply with requirements.

B. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.4 QUALITY ASSURANCE

A. Comply with Division 01 requirements and governing codes and regulations.

B. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for 5 years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Acceptable manufacturers and fabricators include, subject to compliance with requirments:
1. Karp Associates, Inc.
2. Meadowcraft, Inc.
3. Milcor/Inryco.
4. Nystrom, Inc.
5. Approved equal.

2.2 COMPONENTS / ACCESSORIES

A. Provide products from a single manufacturer and equal or superior to basis of design and specified performance.

B. In the absence of other indications provide the following Milcor model types:

Surface	**Model**	**Depth**
Drywall	ATR	3.25 inch
Plaster	AP	2.75 inch
Spline acoustic tile	AT	2.75
Exposed panels	UFR and UFR-DW	

Provide fire rated types at type X drywall and fire rated assemblies.

C. Operation: Hinges spring-loaded concealed type, including extracting pin at hinge leaf to permit panel removal. Locks shall be flush, screwdriver-operated steel cam.

D. Finish: Except where stainless steel is indicated, access doors shall be factory electro-static prime painted.
1. Use of stainless steel: Where shown, and in public bath and wet areas.

E. Where finish is not indicated in baths, and wet areas, use stainless steel.

F. Fire Rated Access Doors: UL fire rated rated door and complying with NFPA 80.
1. Components: Frame 16-gage, 20-gage door panel. I
2. Insulation: 1-15/16" rock wool, sandwiched between inner and outer door panels.
3. Hinges: Continuous and
4. Panel hardware:
   a. Automatic closer.
   b. Lock self-latching with knurled knob plus mortise cylinder.
5. Doors: Equipped with interior latch release mechanism. Doors shall include
6. Anchors: factory attached.
7. Finish as specified above for respective areas.
8. UL label: Required, showing rating for temperature of 2500 degrees F.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the provisions of Division 01 and in particular, Section 01 70 00.

B. Install materials and systems in accordance with manufacturer's instructions, limitations and restrictions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.

C. Examination:
1. Verify that field conditions are acceptable and are ready to receive work.
2. Verify that post size, post spacing, and cable spacing are in accordance with approved shop drawings.

D. Coordinate work with other trades for proper quantities and sizes at actual locations determined by field conditions. Refer to Plumbing, HVAC, Fire Protection and Electrical Drawings requiring access doors.INSTALLATION

E. Do all cutting, drilling, tapping and fitting required to secure work in position and, as necessary to accommodate work of other sections.

F. Install components plumb and level, accurately fitted, free from distortion or defects, and as follows:
1. Anchor assemblies securely to structure.
2. Separate dissimilar materials with bushings, gaskets, grommets, washers or coatings where required to prevent electrolytic corrosion.
3. Use manufacturer's supplied components and hardware unless otherwise shown.

3.2 ADJUSTING / CLEANING / PROTECTION

A. Comply with manufacturer recommendations and the following:
1. Adjust components or connecting hardware in accordance with manufacturer's instructions.
2. Remove temporary coverings and protection of adjacent work areas.

3. Clean installed products in accordance with manufacturer's instructions before owner's acceptance.
4. Remove from project site and legally dispose of construction debris associated with this work
5. Protect installed products until completion of project.
6. Repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 08 42 20 – ALUMINUM-FRAMED ENTRANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 specification sections, apply to this Section.

B. Section Includes, without limitation, providing:
1. Exterior manual-swing entrance doors and door-frame units.
2. Transoms.
3. Vestibule doors.
4. Frames for doors.
5. Hardware, sealants & accessories.

C. Related requirements includes, without limitation:
1. Section 07 92 00 - Sealants, except as specified here.
2. Section 08 44 10 - Aluminum glazed curtainwall.
3. Section 08 71 00 - Finish hardware, except as specified here.
4. Section 08 80 10 - Exterior Glass

1.2 PERFORMANCE REQUIREMENTS

A. Comply with applicable codes, standards and regulations including:
1. ADA: Americans for Disability Act.
2. Code and other indicated wind loads.
3. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.

1.3 SUBMITTALS

A. Comply with Division 1 General Requirements and submit for approval:
1. Product Data: Manufacturer's literature including installation instructions, use restrictions and limitations.
2. Shop drawings: Large scale drawings for fabrication, installation and erections including plans, elevations, details, anchorages, connections and accessories along with head, jamb, sill and joining details. Provide templates for work installed by others.
   a. Field Measurements: Take accurate field measurements before fabrication and indicate same on shop drawings.
3. Initial Selection samples: Provide samples of color and material ranges.
4. Verification: Submit final samples of selected products. Include samples showing full variation of color and finish expected.
5. Maintenance Data: Provide recommended maintenance procedures.
6. Certification: Certify submitted materials comply with requirements.
7. Mock-Up/Field Samples: Prior to installation, provide mock up of each type of system proposed for use for approval. Accepted mock-ups may be incorporated into the work unless otherwise noted.

B. Product Test Reports: Submit manufacturer's certified independent lab test reports not more than 2 years old documenting product performance.

C. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.4 PRODUCT REQUIREMENTS

A. Comply with product requirements, delivery storage and handling provisions of Division1 and the following:
1. Do not deliver panels until job is ready for installation.

2. Provide protective coatings on extrusions.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Acceptable manufacturers include:
1. Kawneer Company, Inc..
2. Tubelite Architectural Products.
3. Vistawall Architectural Products.
4. YKK AP America Inc.
5. Approved equal.

B. Basis of design: Kawneer 500 TuffLine Wide stile.

2.2 MATERIALS

A. Door and framing sections:
1. Material: Extruded aluminum 6063 T5 temper. Sheet aluminum shall be 5005.
2. Surfaces, textures, types: Compatible with specified finishes.
3. Principle components:.125" in thickness.
4. Break metal / glazing moldings: 0.050" thick or heavier.

B. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.

C. Fasteners:
1. Material: Screws, stainless steel, or zinc-plated or corrosion-resistant (ASTM A-164) materials of sufficient strength to perform the functions for which they are used. Exposed fasteners, where approved, shall be of.
2. Exposed fastener finish: Match adjacent surfaces

D. Aluminum composites: Alucobond or Reynobond resin core aluminum facer and backer panels finished to match framing.

2.3 SWINGING STILE DOORS [HEAVY DUTY TUFFLINE]

A. Model/Series: As shown, if not shown, based on Kawneer Wide stile 500 Heavy Wall TuffIlne Entrance designed for high traffic applications.
1. Stile width: As shown, if not: 5 inch.
2. Head rail height: As shown, if not: 3.5 inch.
3. Intermediate rail: As shown, if not: 8.25 inch.
4. Bottom rail: As shown, if not: 10 inch.
5. Wall thickness: 3/16 inch minimum.
6. Door thickness: 2 inch.
7. Glazing moldings/trim: 0.050 inch thick or more.
8. Fasteners: Concealed, and as specified.
9. Provide adjustable glass jacks to help center the glass in the door opening.
10. Thermal break: No.

B. Weatherstripping: 4 sides integrally with door and/or frame and meeting rails.
1. Model: Based on Kawneer "Sealer" system.
2. Door Bottom: Sweep surface applied to bottom rail[s].
3. Air infiltration: ASTM E283, 0.5 cfm at 1.57 psf.
4. Maintenance: Readily replaceable.

C. Construction:
1. Intermediate cross rail: Provide where shown, without exposed fastenings.
2. Corner construction: Sigma deep penetration weld and non-corrosive mechanical fastenings reinforced and sealed with "Locktite" or equal.

3. Glazing stops: Snap in type with neoprene type glazing without exposed screws.
4. Stops on exterior side: Lock-in tamperproof type.
5. Door leaf: Equipped with adjustable mechanism located in top rail near lock stile for minor clearance adjustments after installation.

E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

F. Hardware: Furnish and install hardware specified in this section. Balance of hardware shall be provided under furnished under Section 08 71 00 and installed under this section. Provide as follows: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and securely lock aluminum-framed entrance doors.
2. Hardware Finish: No. 4 Stainless steel polish or clear anodized aluminum as required unless otherwise noted.
3. Closers: Provide delayed action, overhead closers based on LCN 4040 series as approved by the Architect.
4. Thresholds: 6063-75 extruded aluminum 204-RI clear anodized coating. One length for each full opening, with factory cutouts to receive pivots for manual and power-operated doors; fastened with countersunk aluminum of stainless steel screws, and set in full bed of sealant.
5. Hinge assemblies: Heavy Duty Offset Pivots.
6. Push/pull: Provide door pulls on both sides of each door leaf for typical doors as follows:
   a. As shown.

2.4 SEALANT, PRIMERS AND BACKER ROD

A. Comply with requirements of section 07 92 00 and the following:
1. Sealant:
   a. Use: Within aluminum framing "metal-to-metal" and perimeter.
   b. Type: Non-sagging, one-part silicone, meeting ASTM C-920, Type S, Grade NS, Class 25, equal to
   c. Acceptable product: Dow Corning #795.
2. Primers: Liquid type approved by sealant manufacturer for intended use.
3. Backing Filler:
   a. Use: For perimeter frame.
   b. Type: Premolded compressible closed-cell extruded polyethylene backer rod.
   c. Acceptable product: "Sonofoam" rod stock by Sonneborn Building Products. or equal approved by the Architect.
   d. Installed diameter: Approximately 33% original size.
4. Bond Breaking Tape: Type recommended by sealant manufacturer for application.

2.5 FINISHES

A. Provide finishes shown, if not, clear anodized aluminum, Type 1 per Section 05 08 00.

2.6 FABRICATION

A. Comply with the following:
1. Complete fabrication work prior to chemical treatment and finish.
2. Weld according to recommendations of AWS.
3. Avoid distortion of discoloration of exposed faces. Grind exposed weld areas smooth and restore mechanical finish condition before proceeding with treatment.
4. Solder and braze only to fill or seal joints (not to form structural joints. Grind smooth and restore finish.
5. Reinforce members and joints with plates, bars, rods or angles for rigidity and strength as needed to fulfill performance requirements.
6. Fit and assemble all work in the shop insofar as practicable.
7. Use rigidly secured joints with hairline contact, unless otherwise shown.

8. Separate unlike metals or alloys with a heavy coating of bituminous paint or other suitable permanent separation as required to prevent galvanic action.
9. Weep water to exterior at bottom frame member. Provide subsills with end and rear dams whether or not shown.
10. Anchor assemblies without distortion or overstressing fasteners. Allow for from expansion and contraction and thermal stresses.
11. Deliver fabricated units and component parts to project site completely identified in accordance with erection diagrams prepared by this erector.
12. Provide clips to anchor assemblies at masonry construction where blocking is not provided or not practical to install.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the provisions of Section 01 70 00.

B. Openings to receive frames will be prepared and square at correct elevations and plane; do not accept openings if they are not satisfactory to receive work.

C. Comply with manufacturer's written instructions and applicable portions of the FGMA Manual regarding preparation and installation.

3.2 INSTALLATION OF DOORS

A. Erect units plumb, square, level and in proper elevation, plane, location and alignment with other work and as follows:
1. Provide adjustment to field variations. All units shall have
2. Provide proper clearances.
3. Install of hardware specified here and in and/or Section 08710 entrance doors. Secure and adjust hardware.
4. Coordinate with other trades for setting work in slab, obtaining templates, and the like.
5. Install thresholds in one continuous length for each full opening, fastened with countersunk aluminum or stainless steel screws and set in full bed of sealant.

3.3 SEALANT APPLICATION

A. Preparation:
1. Remove particles of mortar, dust and other foreign matter from joints just prior to caulking.
2. Coated with primer.
3. Pack back of joints tightly with foam filler, and/or bond breaking tape

B. Application:
1. Apply sealant at metal-to-metal within framing and at perimeter joints of framing system and flashing.
2. Comply with provisions of Section 07 92 00.

END OF SECTION

SECTION 08 43 00 – ALUMINUM FRAMED STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 specification sections, apply to this Section.

B. Section Includes, without limitation, providing:
1. Storefront window framing, thermal break type.
2. Hardware, sealants & accessories.
3. Break metal work.
4. Glazed-in metal panels.
5. Framing for entrances and vestibules.

C. Related requirements includes, without limitation:
1. Section 07 92 00 Sealants, except as specified here.
2. Section 08 44 10 Glazed Aluminum Curtain Walls
3. Section 08 51 22 Concealed venting alum windows
4. Section 08 80 10 Exterior Glass
5. Section 08 80 20 Interior Glass

1.2 PERFORMANCE REQUIREMENTS

A. Comply with applicable codes, standards and regulations including:
1. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.

1.3 SUBMITTALS

A. Comply with Division 1 General Requirements and submit for approval:
1. Product Data: Manufacturer's literature including installation instructions, use restrictions and limitations.
2. Shop drawings: Large scale drawings for fabrication, installation and erections including plans, elevations, details, anchorages, connections and accessories along with head, jamb, sill and joining details. Provide templates for work installed by others.
   a. Field Measurements: Take accurate field measurements before fabrication and indicate same on shop drawings.
3. Initial Selection samples: Provide samples of color and material ranges.
4. Verification: Submit final samples of selected products. Include samples showing full variation of color and finish expected.
5. Maintenance Data: Provide recommended maintenance procedures.
6. Certification: Certify submitted materials comply with requirements.
7. Mock-Up/Field Samples: Prior to installation, provide mock up of each type of system proposed for use for approval. Accepted mock-ups may be incorporated into the work unless otherwise noted.

B. Product Test Reports: Submit manufacturer's certified independent lab test reports not more than 2 years old documenting product performance.

C. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.4 PRODUCT REQUIREMENTS

A. Comply with product requirements, delivery storage and handling provisions of Division1 and the following:
1. Do not deliver panels until job is ready for installation.
2. Provide protective coatings on extrusions.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Acceptable manufacturers include:
1. Oldcastle.
2. Kawneer Company, Inc.
3. YKK AP America.
4. Approved equal.

B. Basis of design: KawneerTribFab VersaGlaze VG 45**1** and where shown, VG 451T, a multi-plane glazing system series.

2.2 MATERIALS

A. Framing sections:
1. Material: Extruded aluminum ASTM B221, alloy 6063-T5 for extrusions; ASTM B209, alloy 5005-H16 for sheets; or other alloys and temper recommended by manufacturer appropriate for specified finish..
2. Surfaces, textures, types: Compatible with specified finishes.
3. Principle components: 0.125" in thickness.
4. Break metal / glazing moldings: 0.050" thick or heavier.
5. Sightlines: Manufacturer standard.

B. Fasteners:
1. Material: Screws, aluminum, non-magnetic stainless steel, or zinc-plated or corrosion-resistant (ASTM A-164) materials of sufficient strength to perform the functions for which they are used. Exposed fasteners, where approved, shall be of.
2. Exposed fastener finish: Match adjacent surfaces

C. Aluminum composites: Alucobond or Reynobond resin core aluminum facer and backer panels finished to match framing.

2.3 STOREFRONT FRAMING

A. Model/Series:
1. Exterior application: As shown, if not, basis of design, for 1 inch insulated glass with thermal barrier.
2. Interior application/typical: Equal to Trifab VG 451, with glass as shown, if not, 0.25 inch, center glazed. At 0.25 inch glass, provide infill snap-in adaptor. [451-VG-029 part number or equal].
3. Framing dimensions: As shown, if not: manufacturer's standard to match specified model, where depth not shown, use 4.5 inch.

B. Construction: Framing shall consist of sections designed to permit
1. Type: Recessed, unobstructed face glazing; and shall provide
2. Glazing Gaskets:
   a. Compression type design, replaceable, molded or extruded, of neoprene, polyvinyl chloride (PVC), or ethylene propylene diene monomer (EPDM).
   b. Profile and hardness as required to maintain uniform pressure for watertight seal.
3. Transition members shall be identical in exterior profile and dimensions to other mullion and frame assemblies.
4. Head conditions: Designed to accommodate deflection.
5. Covers: Snap-on over pressure plate with sharp, uninterrupted exterior profile.

C. Framing thermal break: Two-part thermal-break construction to form separate interior and exterior frames interlocked by continuous rigid vinyl insulating strips permitting independent movement of respective frames free of all shear or tensile stress.

D. Brake metal sheet stock:
1. Minimum gage .050" thick
2. Profiles: As indicated and to suit job conditions.
3. Sill conditions: As detailed, if not, provide subsill with rear and end dams.

4. Curved components: As show, and custom fabricated, formed, welded, ground smooth and finished after fabrication.
5. Aluminum composites: Provide resin core products as required to eliminate oil canning or to accomplish indicated details.
6. Glazed in break metal: Where shown or where practical, glaze aluminum composites and break metal into gasketed glazing pockets.

E. Miscellaneous components:
1. Internal Reinforcing: ASTM A36 for carbon steel. Shapes and sizes to suit installation.
   a. Steel components factory coated with alkyd type zinc chromate primer complying with FS TT-P-645.
2. Anchorage Devices: Manufacturer's standard formed or fabricated steel or aluminum assemblies of shapes, plates, bars or tubes.
   a. Hot-dip galvanize steel assemblies after fabrication, comply with ASTM A123, 2.0 ounce minimum coating.
3. Expansion Anchor Devices: Lead-shield or toothed-steel, drilled-in, expansion bolt anchors.
4. Protective Coatings: Cold-applied asphalt mastic complying with SSPC, compounded for 30 mil thickness for each coat; or alkyd type zinc chromate primer complying with FS TT-P-645.
5. Touch-Up Primer for Galvanized Components: Zinc oxide conforming with FS TT-P-641.

F. Insulated in-fill panels: Where aluminum composites are not required or shown, provide:
1. Minimum gage .050" thick
2. Profiles: As indicated and to suit job conditions.
3. Sill conditions: As detailed, if not, provide subsill with rear and end dams.
4. Curved components: As shown, and custom fabricated, formed, welded, ground smooth and finished after fabrication.
5. Aluminum composites: Provide resin core products as required to eliminate oil canning or to accomplish indicated details.
6. Glazed in break metal: Where shown or where practical, glaze aluminum composites and break metal into gasketed glazing pockets.
7. Insulation: Adhere non-combustible insulation to inside face of panels, using material equal to Thermafiber 45, in thickness shown, if not shown, 1.5 inch.
1. Factory glaze insulating panels into frame or sash using indicated products. Where type not indicated provide units equal as follows:

2.4 SEALANT, PRIMERS AND BACKER ROD

A. Comply with requirements of section 07 92 00 and the following:
1. Sealant:
   a. Use: Within aluminum framing "metal-to-metal" and perimeter.
   b. Type: Non-sagging, one-part silicone, meeting ASTM C-920, Type S, Grade NS, Class 25, equal to
   c. Acceptable product: Dow Corning #795.
2. Primers: Liquid type approved by sealant manufacturer for intended use.
3. Backing Filler:
   a. Use: For perimeter frame.
   b. Type: Premolded compressible closed-cell extruded polyethylene backer rod.
   c. Acceptable product: "Sonofoam" rod stock by Sonneborn Building Products. or equal approved by the Architect.
   d. Installed diameter: Approximately 33% original size.
4. Bond Breaking Tape: Type recommended by sealant manufacturer for application.

2.5 FINISHES

A. Provide finishes shown, if not, kynar coated Type 4 per Section 05 08 00.

2.6 FABRICATION

A. Comply with the following:
1. Complete fabrication work prior to chemical treatment and finish.

2. Weld according to recommendations of AWS.
3. Avoid distortion of discoloration of exposed faces. Grind exposed weld areas smooth and restore mechanical finish condition before proceeding with treatment.
4. Solder and braze only to fill or seal joints (not to form structural joints. Grind smooth and restore finish.
5. Reinforce members and joints with plates, bars, rods or angles for rigidity and strength as needed to fulfill performance requirements.
6. Fit and assemble all work in the shop insofar as practicable.
7. Use rigidly secured joints with hairline contact, unless otherwise shown.
8. Separate unlike metals or alloys with a heavy coating of bituminous paint or other suitable permanent separation as required to prevent galvanic action.
9. Weep water to exterior at bottom frame member. Provide subsills with end and rear dams whether or not shown.
10. Anchor assemblies without distortion or overstressing fasteners. Allow for from expansion and contraction and thermal stresses.
11. Deliver fabricated units and component parts to project site completely identified in accordance with erection diagrams prepared by this erector.
12. Provide clips to anchor assemblies at masonry construction where blocking is not provided or not practical to install.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the provisions of Section 01700 - especially requirements related to:
1. Inspection and examination. Tolerances and measurement.
2. Approvals, inspections and filed quality control.
3. Layout. Adjusting.
4. Cleaning. Protection.

B. Openings to receive frames will be prepared and square at correct elevations and plane; do not accept openings if they are not satisfactory to receive work.

C. Comply with manufacturer's written instructions and applicable portions of the FGMA Manual regarding preparation and installation.

3.2 TOLERANCES

A. Install framing systems to comply with the following maximum erection tolerances:
1. Location and Plane: Limit variation to 1/8 inch in 12 feet; 1/4 inch over total length.
2. Alignment, surfaces abut in line: Limit offset to 1/16 inch.
3. Alignment, surfaces meet at corners: Limit offset to 1/32 inch.
4. Diagonal Measurements: Limit difference to 1/8 inch.

3.3 INSTALLATION AND ERECTION OF FRAMING

A. Comply with manufacturer installation requirements and the following:
1. Set units level, plumb, and true to line, with uniform joints in proper alignment.
2. Support on metal shims and secure in place by bolting to clip angles, inserts and similar supports, and securely anchor to supporting structure.
3. Use only types of equipment, ropes, wedges, spacers, shims and other items during erection which will not stain or mar the finish of units.
4. Do not cut or trim finished component parts during erection.
5. Do not cut through reinforcing members.
6. Do not erect members which are observed to be warped, bowed, deformed or otherwise damaged or defaced to such extent as to impair strength or appearance. Remove and replace members damaged in the process of erection, as directed.
7. Form flashings to detail, forming counterflashing and other elements shown.
8. Paint clip angles, and other ferrous metal parts which will be concealed, with a zinc-chromate paint.

9. Provide metal-to-metal and perimeter sealant at exterior surfaces of units.
10. Secure neoprene glazing strips and caps in-place to make ready for glazing operation.
11. Install doors and hardware in accordance with manufacturer's printed instructions.
12. Anchor securely in place, allowing for required movement, including expansion and contraction.
13. Separate dissimilar materials at contact points, including metal in contact with masonry or concrete surfaces, with bituminous paint or preformed separators to prevent contact and corrosion.
14. Set sill members in bed of sealant. Set other members with internal sealants and baffles to provide weather-tight construction.

3.4 SEALANT APPLICATION

A. Preparation:
1. Remove particles of mortar, dust and other foreign matter from joints just prior to caulking.
2. Coated with primer.
3. Pack back of joints tightly with foam filler, and/or bond breaking tape

B. Application:
1. Apply sealant at metal-to-metal within framing and at perimeter joints of framing system and flashing.
2. Comply with provisions of Section 07920.

C. FIELD QUALITY CONTROL
1. Testing and Inspecting: Owner may engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as
2. Inspections: Special inspections according to the "International Building Code."

3.5 ADJUSTING, CLEAN UP & PROTECTION

A. Comply with Section 01 70 00.

END OF SECTION

SECTION 08 44 33 - SLOPED GLAZING ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Sloped glazing assemblies.
2. Outside pressure plate system.
3. Engineering by fabricator, aka delegated design.

1.2 PERFORMANCE REQUIREMENTS:

A. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum sloped glazing representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
1. Glazed aluminum sloped glazing shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads. Failure also includes the following:
   a. Thermal stresses transferring to building structure.
   b. Glass breakage.
   c. Loosening or weakening of fasteners, attachments, and other components.
   d. Failure of operating units.

B. Delegated Design: Design glazed aluminum sloped glazing, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated

C. Loads: As indicated on drawings, but in no case case less than required by building code, including:
1. Inward wind pressure: As shown.
2. Outward wind pressure: As shown.
3. Snow load: As shown.

D. Limit deflection of framing members normal to wall plane to 1/175 of clear span, but limited as follows:
1. For spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm)
2. For spans greater than 13 feet 6 inches (4.1 m)] or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.

E. Limit deflection of framing members parallel to glazing plane to L/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.

F. Structural Testing: Systems tested according to ASTM E 330 at 150 percent of inward and outward wind-load design pressures do not evidence material failures, structural distress, deflection failures, or permanent deformation of main framing members exceeding 0.2 percent of clear span.

G. Air Infiltration: Limited to 0.06 cfm/sq. ft. of system surface area when tested according to ASTM E 283 at a static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa)].

H. Water Penetration: Systems do not evidence water leakage when tested according to ASTM E 331 at minimum differential pressure of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft, and as follows:
1. Static water resistance: 12 pounds per square foot per AAMA 501.1.
2. Dynamic water resistance: 12 pounds per square foot per AAMA 501.1.

I. Thermal Transmittance: Average U-factor as determined according to AAM 1503 of not more than:
1. 0.46 Btu/sq. ft. x h x deg F.

J. Thermal Transmittance: Average U-factor as determined according to NFRC 100 of not more than:
1. 0.45 Btu/sq. ft. x h x deg F (2.55 W/sq. m x K)

K. Condensation Resistance (CRF): Per AAMA 1503, not be less than 68 frame and 66 glass (clear).

L. Environmental Product Declaration (EPD): Type III Product-Specific EPD created from Product Category Rule.

1.3 SUBMITTALS

A. Comply with Division 01 General Requirements and submit for approval:
1. Product Data: Manufacturer's literature including installation instructions, use restrictions and limitations.
2. Shop drawings: Large scale drawings for fabrication, installation and erections including plans, elevations, details, anchorages, connections and accessories along with head, jamb, sill and joining details. Provide templates for work installed by others.
   a. Field Measurements: Take accurate field measurements before fabrication and indicate same on shop drawings.
   b. Engineering analysis: Structural analysis data signed and sealed by a qualified professional engineer registered in the jurisdiction.
3. Samples: Provide samples of color and material ranges.
4. Product test reports showing compliance with criteria.
5. Maintenance Data: Provide recommended maintenance procedures.
6. Certification: Certify submitted materials comply with requirements.

B. Mock-Up/Field Samples: Prior to installation, provide mock up of each type of system proposed for use for approval. Accepted mock-ups may be incorporated into the work unless otherwise noted.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Installer with successful experience of the same or similar systems required of similar size and scope.

B. Manufacturer Qualifications: A manufacture regularly engaged in manufacture of glazed aluminum sloped glazing systems, that meet or exceed performance requirements.

C. Source Limitations: Obtain aluminum famed assemblies through one source from a single manufacturer.

1.5 WARRANTY

A. ASDFKL

B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's warranty.
1. Warranty Period: 2 years from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SLOPED GLAZING SYSTEM MANUFACTURERS

A. Available manufacturers, subject to compliance with specifications:
1. Kawneer North America; an Alcoa company.
2. Wausau Window and Wall Systems.
3. Oldcastle Building Envelope.
4. Approved equal.

B. Basis of design:
1. Manufacturer: Kawneer Company Inc.
2. Series: 1600 Sloped Glazing.
3. System depth: As shown, if not ,2-1/2" x 4-3/4" (63.5 x 120.7) or 2-1/2" x 6" (63.5 x 152.4), outside glazed pressure plate system.
4. Tested to AAMA 501.

2.2 SLOPED GLAZING SYSTEM COMPONENTS

A. Aluminum: ASTM B 209 (ASTM B 209M) sheet; ASTM B 221 (ASTM B 221M) extrusions 6063-T6 alloy and temper.

B. Framing Members:
1. Framing-Member Type: Self-supporting
2. Glass Retention: As shown, if not:
   a. Pressure caps on four sides
   b. Glazing plane: Front.

C. Glazing: Insulating glass specified in Division 08 Section "Glazing."
1. Insulating glass: As shown, if not, 1 inch thick units, matching glass, spacers and similar components specified for exterior glass.

D. Structural Silicone Sealant: ASTM C 1184, compatible with system components.
1. Color: As shown, if not, as selected.

E. Secondary Sealant: ASTM C 920, Type S, Grade NS, Class 25, compatible with structural sealant and other system components.
1. Color: Matching structural sealant.

F. Fasteners and Accessories: Compatible with adjacent materials, corrosion resistant, nonstaining, and nonbleeding. Finish exposed fasteners to match framing components. Use non-magnetic stainless-steel screws, ASTM A 193/A 193M for fastening aluminum cap retainers and cover fasteners with aluminum trim.

G. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.

H. Pressure Plate: Aluminum and fastened to mullions with stainless steel screws.

I. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.

J. Thermal Barrier: Thermal separator extruded of silicone compatible PVC (Poly Vinyl Chloride).

K. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil [0.762mm] thickness per coat.

2.3 FABRICATION:

A. Factory assemble units to the greatest extent possible. Form or extrude aluminum shapes before finishing.

B. 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.
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 exterior.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
7. Internal weeping system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum sloped glazing to exterior.

C. Sloped Glazing Framing: Fabricate components for assembly following manufacturer's standard installation instructions.

D. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.4 FINISH

A. Aluminum Finish: As shown, if not, refer to section called “Factory applied metal coatings” and use Type 4. Color as selected by architect.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install sloped glazing systems plumb, level, and true to line, without warp or rack of frames with manufacturer’s prescribed tolerances and installation instructions. Provide support and anchor in place.
1. Glazing: Glass shall be outside glazed and held in place with extruded aluminum pressure plates anchored to the mullion using stainless steel fasteners spaced no greater than 9" (228.6) on center.
2. Water Drainage: Each light of glass shall be compartmentalized using joint plugs and silicone sealant to divert water to the horizontal weep locations. Weep holes shall be located in the horizontal pressure plates and covers to divert water to the exterior of the building.

B. Related Products Installation Requirements:
1. Sealants (Perimeter): Refer to Joint Treatment (Sealants) Section.
2. Glass: Refer to Glass and Glazing Section.
3. Reference: ANSI Z97.1, CPSC 16 CFR 1201 and GANA Glazing ManualGeneral:

C. Rigidly secure nonmovement joints. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding. Seal joints watertight unless otherwise indicated.

D. Isolate metal surfaces in contact with incompatible materials, including wood, by painting contact surfaces with bituminous coating or primer, or by applying sealant or tape recommended by manufacturer.

E. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the sloped glazing assembly to exterior.

F. Install framing components true in alignment with established lines and grades to the following tolerances:
1. Level: 1/8 inch in 20 feet (3 mm in 6 m); 1/4 inch in 40 feet (6 mm in 12 m).
2. Aligned Surfaces: Limit offset from true alignment to 1/32 inch (0.79 mm) for surfaces separated by less than 3 inches (76.2 mm), otherwise limit offset to 1/8 inch (3 mm).
3. Location: Limit variation from plane or location to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/2 inch (12.7 mm) over total length.

3.2 FIELD QUALITY CONTROL

A. Repair or remove and replace Work that does not meet requirements or that is damaged by testing and retest.

B. Testing: Testing shall be performed per AAMA 503 by a qualified independent testing agency..
1. Air Infiltration Tests: Conduct tests in accordance with ASTM E 783. Allowable air infiltration shall not exceed 1.5 times the amount indicated in the performance requirements or 0.09 cfm/ft2, which ever is greater.
2. Wter Infiltration Tests: Conduct tests in accordance with ASTM E 1105. No uncontrolled water leakage is permitted when tested at a static test pressure of two-thirds the specified water penetration pressure but not less than 8 psf (383 Pa).

3.3 ADJUSTING, CLEANING & PROTECTION

A. Protection: Protect installed product’s finish surfaces from damage during construction. Protect aluminum sloped glazing system from damage from grinding and polishing compounds, plaster, lime, acid, cement, or other harmful contaminants.

B. Cleaning: Repair or replace damaged installed products. Clean installed products in accordance with manufacturer’s instructions prior to owner’s acceptance. Remove construction debris from project site and legally dispose of debris.

C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION

SECTION 08 45 10 - TRANSLUCENT INSULATED PANEL ASSEMBLIES

PART 1 - - GENERAL

1.1 SUMMARY

A. Related Documents: All the Contract Documents and provisions, including the Drawings, and Division 1 General Requirements apply to the work of this Section.

B. Section includes furnishing and installing:
1. Flat factory prefabricated structural insulated translucent sandwich panels.
2. Aluminum installation system.
3. Aluminum flashing.
4. Use as skylight sloped glazing.

C. Related Sections:
1. Division 07 - Flashing and Sheet Metal
2. Division 07 - Sealants

1.2 SUBMITTALS

A. Submit manufacturer's product data. Include construction details, material descriptions, profiles and finishes of skylight components.

B. Submit shop drawings. Include plans, details, dimensions and attachments to other work.

C. Submit manufacturer's color charts showing the full range of colors available for factory finished aluminum.
1. When requested, submit samples for each exposed finish required, in same thickness and material indicated for the work and in size indicated below. If finishes involve normal color variations, include sample sets consisting of two or more units showing the full range of variations expected.
   a. Sandwich panels: 14" x 28" units
   b. Factory finished aluminum: 5" long sections

D. Submit Installer Certificate, signed by installer, certifying compliance with project qualification requirements.

E. Submit product test reports from a qualified independent testing agency indicating each type and class of skylight panel system complies with the project performance requirements, based on comprehensive testing of current products. Previously completed test reports will be acceptable if for current manufacturer and indicative of products used on this project.
1. Test reports required are:
   a. Flame Spread and Smoke Developed (UL 723) – Submit UL Card
   b. Burn Extent (ASTM D-635)
   c. Color Difference (ASTM D-2244)
   d. Abrasion/Erosion Resistance (ASTM D-4060)
   e. Impact Strength (UL 972)
   f. Bond Tensile Strength (ASTM C-297 after aging by ASTM D-1037)
   g. Bond Shear Strength (ASTM D-1002)
   h. Beam Bending Strength (ASTM E-72)
   i. Insulation U-Factor (NFRC-100)
   j. NFRC System Certification
   k. Condensation Resistance Factor (AAMA 1503)
   l. Class A Roof Covering Burning Brand (ASTM E-lO8) UL Listed Class A Roof System (UL 790) (Optional) – Submit UL Card
   m. Blast Analysis and Testing of Translucent Sandwich Panels Demonstrating Equivalent Performance to 1/4" Laminated Glass per DoD UFC 4-010-01 (Optional)

F. Submit current documentation indicating regular, independent quality control monitoring under a nationally recognized building code review and listing program.

G. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications
1. Material and products shall be manufactured by a company continuously and regularly employed in the manufacture of specified materials for a period of at least ten (10) consecutive years and which can show evidence of those materials being satisfactorily used on at least six (6) projects of similar size, scope and location. At least three (3) of the projects shall have been in successful use for ten (10) years or longer.
2. Skylight system must be listed by the International Code Council – Evaluation Service (ICC-ES) which requires quality control inspections and fire, structural and water infiltration testing of sandwich panel systems by an approved agency.
3. Quality control inspections and required testing shall be conducted at least once each year and shall include manufacturing facilities, sandwich panel components and production sandwich panels for conformance with "Acceptance Criteria for Sandwich Panels" as regulated by the ICC-ES.

B. Installer's Qualifications: Installation shall be by an experienced installer, which has been in the business of installing specified skylight systems for at least five (5) consecutive years and can show evidence of satisfactory completion of projects of similar size, scope and type.

C. Performance Requirements: The manufacturer shall be responsible for the configuration and fabrication of the complete skylight panel system.
1. When requested, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 PERFORMANCE REQUIREMENTS

A. The manufacturer shall be responsible for the configuration and fabrication of the complete skylight panel system.
1. When requested, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Standard skylight system shall have less than 0.01 cfm/ft² air leakage by ASTM E 283 at 6.24 PSF (50 mph) and no water penetration by ASTM E 331 at 15 PSF; and structural testing by ASTM E 330.
3. Structural Loads; Provide system capable of handling the loads indicated in structural documents, if not, as follows:
   a. Live Load: 40 PSF
   b. Snow Load: 35 PSF; Drift Load: 40 PSF
   c. Wind Load: 30PSF

1.5 DELIVERY STORAGE AND HANDLING

A. Deliver skylight system, components and materials in manufacturer's standard protective packaging.

B. Store skylight panels on the long edge, several inches above the ground, blocked and under cover in accordance with manufacturer's storage and handling instructions.

1.6 WARRANTY

A. Submit manufacturer's and installer's written warranty agreeing to repair or replace skylight system work which fails in materials or workmanship within one (1) year of the date of delivery. Failure of materials or workmanship shall include leakage, excessive deflection, deterioration of finish on metal in excess of normal weathering and defects in accessories, insulated translucent sandwich panels and other components of the work. (Contact local representative for extended warranty periods.)

B. Provide an extended warranty of 5 years for material and workmanship.

PART 2 - - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide one of the following:
1. Kalwall Corporation; www.kalwall.com/.
2. Glasscorp; www.glasscorp.com/.
3. Major Industries; www.majorskylights.com/.
4. Extech/Exterior Technologies ; www.extechinc.com
5. Structures Unlimited, Inc.; www.structuresunlimitedinc.com/.
6. Approved equal.

2.2 PANEL COMPONENTS

A. Face Sheets
1. Translucent faces: Manufactured from glass fiber reinforced thermoset resins, formulated specifically for architectural use.
   a. Thermoplastic (e.g. polycarbonate, acrylic) faces are not acceptable.
2. Exterior face sheets:
   a. Color stability: Full thickness of the exterior face sheet shall not change color more than 3 CIE Units DELTA E by ASTM D 2244 after 5 years outdoor South Florida weathering at 5° facing south, determined by the average of at least three white samples with and without a protective film or coating to ensure long-term color stability. Color stability shall be unaffected by abrasion or scratching.
   b. Strength: Exterior face sheet shall be uniform in strength, impenetrable by hand held pencil and repel an impact minimum in ft. lbs. without fracture or tear when impacted by a 3-1/4" diameter, 5 lb. free-falling ball per UL 972. Imact strength shall meet the following:
      1) .070" thick exterior face is 70 ft. lbs. for 0.070 inch thick exterior face
      2) 230 ft. lbs for HI-Impact [manufacturer optional] exterior face.
3. Flammability of interior face sheets:
   a. Flamespread: Underwriters Laboratories (UL) listed, which requires periodic unannounced retesting, with flamespread rating no greater than 50 (20) and smoke developed no greater than 250 (200) when tested in accordance with UL 723.
   b. Burn extent by ASTM D-635 shall be no greater than 1".
   c. Face sheets shall not deform, deflect or drip when subjected to fire or flame.
   d. Face sheets shall not delaminate when exposed to 200°F for 30 minutes per IBC and NBC (300°F for 25 minutes per UBC and SBC).
4. Weatherability of exterior face sheets:
   a. Color stability: Full thickness of the exterior face sheet shall not change color more than 3.0 (7.0) CIE Units DELTA E by ASTM D-2244 after 5 years (30 months) outdoor South Florida weathering at 5 degrees facing south, determined by the average of at least three (3) white samples with and without a protective film or coating to ensure long-term color stability. Color stability shall be unaffected by abrasion or scratching.
   b. Erosion barrier: Exterior face shall have a permanent glass erosion barrier embedded beneath the surface to provide long-term resistance to reinforcing fiber exposure. Exterior face surface loss shall not exceed .7 mils and 40 mgs when tested in accordance with ASTM D-4060 employing CS17 abrasive wheels at a head load of 500 grams for 1000 cycles. Sacrificial surface films or coatings are not acceptable erosion barriers.
5. Appearance:
   a. Exterior face sheets: Smooth, 0.070" thick .
   b. Interior face sheets: Smooth, 0.045" thick .
   c. Face sheets shall not vary more than +/- 10% in thickness and be uniform in color.
6. Strength: Exterior face sheet shall be uniform in strength, impenetrable by hand held pencil and repel an impact equal to 70 (230) ft. lbs. without fracture or tear when impacted by a 3-1/4" diameter, 5 lb. free-falling ball per UL 972.

B. Grid Core

1. Thermally broken (aluminum and composite) I-beam grid core shall be of 6063-T6 or 6005-T5 alloy and temper with provisions for mechanical interlocking of muntin-mullion and perimeter. Width of I- beam shall be no less than 7/16". The I-beam grid shall be machined to tolerances of not greater than +/- .002".
2. Thermal break: Minimum 1 inch thermoset fiberglass composite.

C. Laminate Adhesive
1. Heat and pressure resin type adhesive engineered for structural sandwich panel use, with minimum 25-years field use. Adhesive shall pass testing requirements specified by the International Code Council "Acceptance Criteria for Sandwich Panel Adhesives."
2. Minimum tensile strength of 750 PSI when the panel assembly is tested by ASTM C-297 after two (2) exposures to six (6) cycles each of the aging conditions prescribed by ASTM D-1037.
3. Minimum shear strength of the panel adhesive by ASTM D-1002 after exposure to five (5) separate conditions:
   a. 50% Relative Humidity at 73° F: 540 PSI
   b. 182° F: 100 PSI
   c. Accelerated Aging by ASTM D-1037 at room temperature: 800 PSI
   d. Accelerated Aging by ASTM D-1037 at 182° F: 250 PSI
   e. 500 Hour Oxygen Bomb by ASTM D-572: 1400 PSI

2.3 PANEL CONSTRUCTION

A. Provide sandwich panels of flat fiberglass reinforced translucent face sheets laminated to a grid core of mechanically interlocking thermally broken (aluminum) I-beams. The adhesive bonding line shall be straight, cover the entire width of the I-beam and have a neat, sharp edge.
1. Thickness:
   a. As shown in 2.75 inch, or 4 inch.
   b. Where thickness is not shown on drawings, provide 4 inch thick units.
2. Grid size: As shown, if not, Nominal 8" x 20"
3. Grid pattern: As shown, if not, Shoji.
4. Light transmission: Manufacturers standard per cent, if none, 35%.
5. Solar heat gain coefficient: 0.52.
   a. U- factor by NFRC certified laboratory: (0.23, 0.14, 0.10, 0.05) thermally broken [OR (0.53, 0.29, 0.22, 0.18) aluminum I-beam].
6. Panel U-factor per NFRC certified laboratory with 2-3/4" aluminum grid: 0.53.

B. Panels characteristics:
1. Deflection: No more than 1.0" at 30 psf in 10'-0" span without a supporting frame by ASTM E-72.
2. Fire resistance: Able to withstand 1200ºF fire for minimum (1)hour without collapse or exterior flaming.
3. Thermally broken panels:
   a. Minimum Condensation Resistance Factor of 80 by AAMA 1503 measured on the bond line.
   b. Minimum CRF of 90 at center of grid cell.

C. Skylight System shall meet the fall through requirements of OSHA 1910.23 as demonstrated by testing in accordance with ASTM E 661, thereby not requiring supplemental screens or railings.

D. Skylight system shall pass Class A Roof Burning Brand Test by ASTM E-108. (**OR** Skylight system shall be UL listed as a Class A Roof by UL 790 which requires periodic unannounced inspections and retesting by Underwriters Laboratories.)

2.4 BATTENS AND PERIMETER CLOSURE SYSTEMS

A. Closure system: Extruded aluminum 6063-T6 and 6063-T5 alloy and temper clamp-tite screw type closure system.
1. Skylight perimeter closures shall be factory sealed to panels

B. Sealing tape: Manufacturer's standard, pre-applied to closure system at the factory under controlled conditions.

C. Fasteners: 300 series stainless steel screws for aluminum closures, excluding final fasteners to the building.

D. Finish: Exposed aluminum to be manufacturer's factory applied finish that meets the performance requirements of Section 05 08 00 – Type 4 – Kynar. Where this finish is not available from manufacturer, provide finishes meeting AAMA 2604.Color: Selected from manufacturer's standard colors.

PART 3 - - EXECUTION

3.1 EXAMINATION

A. Examine substrates, supporting structure and installation conditions. Do not proceed with skylight erection until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Metal Protection:
1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint or method recommended by manufacturer.
3. Where aluminum will contact pressure-treated wood, separate dissimilar materials by methods recommended by manufacturer.

3.3 INSTALLATION

A. Install the skylight system in accordance with the manufacturer's installation recommendations and approved shop drawings.
1. Anchor component parts securely in place by permanent mechanical attachment system.
2. Accommodate thermal and mechanical movements.
3. Set sill and curb members in a full bed of sealant compound, or with joint fillers or gaskets to provide weather-tight construction.

B. Install joint sealants at perimeter joints and within the skylight system in accordance with manufacturer's installation instructions.

3.4 FIELD QUALITY CONTROL

A. Water Test: Test assemblies according to procedures in AAMA 501.2.

B. Repair or replace work that does not pass testing or that is damaged by testing and retest work.

3.5 CLEANING

A. Clean the skylight system inside and outside, immediately after installation, according to manufacturer's written recommendations.

END OF SECTION

SECTION 08 62 10 – METAL FRAMED UNIT SKYLIGHTS

PART 1 - GENERAL

1.1 SUMMARY

A. Related documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Aluminum-framing for skylights.
2. Factory installed glass and glazing for skylights.
3. Skylight flashing.
4. Accessories.

C. Related Sections include the following:
1. Section 08 80 10 – Exterior Glass: standards and requirements.

1.2 PERFORMANCE REQUIREMENTS

A. General: Provide metal-framed skylights capable of withstanding loads and thermal and structural movements indicated without failure. Failure includes the following:
1. Deflection exceeding specified limits.
2. Thermal stresses transferred to the building structure.
3. Framing members transferring stresses, including those caused by thermal and structural movement, to glazing.
4. Noise or vibration created by thermal and structural movement and wind.
5. Loosening or weakening of fasteners, attachments, and other components.
6. Sealant failure.

B. Deflection Limits: As follows:
1. Deflection of the entire length of framing members in direction normal to glazing plane is limited to 1/180 of clear span or 3/4 inch (19 mm), whichever is smaller, unless otherwise indicated.
2. Deflection of the entire length of framing members for spans exceeding 20 feet (6 m) is limited to 1/240 of clear span.
3. Deflection of framing members in a direction parallel to glazing plane, when carrying full dead load, is limited to an amount not exceeding that which reduces glazing bite below 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 (3.2 mm).

C. Lateral Support: Compression flanges of flexural members are laterally braced by cross members with minimum depths equal to 50 percent of flexural member depth and by anchors to the building structure. Glazing material does not provide lateral support.

D. Structural Loads: Provide metal-framed skylights, including anchorage, capable of withstanding the effects of the following design loads when supporting full dead loads:
1. Wind Loads: As indicated on structural documents
2. Snow Loads: As indicated on structural documents.
3. Roof Loads: As follows:
   a. Concentrated Load: 250 lbf (1112 N) applied to framing members at location that produces the most severe stress or deflection.
   b. Live Load: As indicated on structural documents.
4. Seismic Loads: As indicated.

E. Structural Performance: Provide metal-framed skylights, including anchorage, capable of withstanding test pressure indicated without material and deflection failures and permanent deformation of structural members exceeding 0.2 percent of span when tested according to ASTM E 330.
1. Test Pressure: 150 percent of positive and negative wind-load design pressures.

2. Test Duration: As required by design wind velocity; fastest 1 mile (1.609 km) of wind for relevant exposure category.

F. Thermal Movement: Provide metal-framed skylights that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, sealant failure, and other detrimental effects.
1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C) material surfaces.
2. Air Infiltration: Provide metal-framed skylights with maximum air leakage of of surface when tested according to ASTM E 283 at a minimum static-air-pressure differential of .

G. Water Penetration: Provide metal-framed skylights that do not evidence water penetration when tested according to ASTM E 331 at a minimum differential static pressure of 20 percent of positive design wind load, but not less than 6.24 lbf/sq. ft. (300 Pa).

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions and profiles of components, and finishes for metal-framed skylights.

B. Shop Drawings: For metal-framed skylights. Include plans, elevations, sections, details, and attachments to other Work.
1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Samples for Initial Selection: Manufacturer's color charts consisting of sections of units showing the full range of colors available for factory-finished aluminum.

D. Samples for Verification: For each exposed aluminum finish required, prepared on 12-inch- (300-mm-) long sections of extrusions or formed shapes in same thickness and material indicated for the Work. If finishes involve normal color variations, include sample sets consisting of two or more units showing the full range of variations expected.

E. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer to assume engineering responsibility who has specialized in installing metal-framed skylights similar to those indicated for this Project and who is acceptable to manufacturer.

H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1. owing:
1. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
2. Review structural load limitations.
3. Review skylight curb structural requirements.
4. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
5. Review protection of adjacent roof areas.
6. Review preparation and other requirements for installing structural silicone sealant.

1.5 WARRANTY

A. General Warranty: Provide manufacturer standard warranty.

B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of metal-framed skylights that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
1. Structural failures.
2. Sealant failures.
3. Failure of systems to meet performance requirements.
4. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

5. Water leakage; defined as uncontrolled water appearing on normally exposed interior surfaces of skylights from sources other than condensation. Water controlled by flashing and gutters and drained back to the exterior and that cannot damage adjacent materials or finishes is not water leakage.
6. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of design manufacturer: Wasco Products, Inc." EPY 42 Series" with integral drainage channel.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Naturalite/EPI Skylight Systems.
2. Fisher Skylights, Inc.
3. EXARC Skylights, Inc.
4. Architectural Skylight Co., Inc.

2.2 FRAMING MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for use and finish indicated, and as follows:
1. Extrusions: ASTM B 221 (ASTM B 221M).
2. Sheet and Plate: ASTM B 209 (ASTM B 209M).
3. Bars, Rods, and Wire: ASTM B 211 (ASTM B 211M).

B. Rafters, purlins, pressure plates:
1. Framing Members: Extruded aluminum alloy 6063-T5 or T6, ASTM B 221 with minimum effective thickness of 0.109 inches.
2. Exterior Pressure Caps: Extruded aluminum alloy 6063-T5 or T6, ASTM B 221 with minimum effective thickness of 0.090 inches.

C. Brackets and Reinforcements: Provide manufacturer's standard high-strength aluminum brackets and reinforcements. Provide nonstaining, nonferrous shims to install and align skylights.

D. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing; compatible with adjacent materials.

E. Exposed Flashing and Closures: Pre-finished, painted, aluminum sheet.
1. Minimum Thickness: 0.060 inch (1.5 mm).

F. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories; compatible with adjacent materials.
1. Movement Joints: Provide slip-joint linings, spacers, and sleeves of material and type recommended by manufacturer.
2. Aluminum-Retaining-Cap Fasteners: ASTM A 193/A 193M, Series 300 stainless-steel screws; type as recommended by manufacturer.
3. Connections to Supporting Structure: ASTM A 307, zinc-coated steel fasteners.
4. Anchor Bolts: ASTM A 307, Grade A, zinc-coated steel anchor bolts.

G. Framing-System Gaskets and Joint Fillers: Manufacturer's standard permanent gaskets and joint fillers for sliding, compression, and nonmoving joints.

H. Framing-System Sealants: Compatible with components with which sealants come in contact and recommended by skylight and sealant manufacturers for this use.

I. Bituminous Paint: Cold-applied asphalt mastic paint complying with SSPC-Paint 12, except containing no asbestos, and formulated for 30-mil (0.8-mm) thickness per coat.

2.3 GLAZING MATERIALS

A. Factory glaze, furnish and install glass and glazing for skylights under this section. Comply with requirements of Section 08 80 10 Exterior Glass. Provide argon fill, low E coating and one sheet of laminated glass and one sheet of tempered glass in insulated glass units.

B. Glazing Gaskets: Manufacturer's standard pressure-glazing gaskets of elastomer type and hardness selected by skylight and gasket manufacturers to comply with requirements. Provide gasket assemblies that have corners sealed with sealant recommended by gasket manufacturer.

C. Spacers, Edge Blocks, and Setting Blocks: Manufacturer's standard permanent nonmigrating type of elastomer type and hardness selected to comply with requirements.

D. Structural Silicone Sealant: ASTM C 1184, compatible with components with which sealant comes in contact, formulated and tested for use as a structural sealant, and neutral curing.
1. Color: As selected, if not, Black.
2. Tensile Strength: 100 psi (690 kPa) minimum.
3. Provide sealant with modulus of elasticity that will not allow movement of more than 25 percent of joint width, unless less movement is required by skylight systems' design.

E. Weatherseal Sealant: Neutral-curing silicone sealant recommended by skylight and sealant manufacturers for this use.
1. Sealant is capable of withstanding 50 percent movement in both extension and compression (total of 100 percent movement) when tested for adhesion and cohesion under maximum cyclic movement according to ASTM C 719.
2. Sealant complies with ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and, as applicable to substrates including other sealants with which it comes in contact, O.
3. Color: Black.

2.4 FABRICATION

A. Framing Components: As follows:
1. Fabricate components that, when assembled, will have accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.
2. Fabricate components to drain water passing joints and to drain condensation and moisture occurring or migrating within skylight system to the exterior.
3. Fabricate components to accommodate expansion, contraction, and field adjustment, and to provide for minimum clearance and shimming at skylight perimeter.
4. Fabricate components to ensure that glazing is thermally and physically isolated from framing members.
5. Form shapes with sharp profiles, straight and free of defects or deformations, before finishing.
6. Fit and assemble components to greatest extent practicable before finishing.
7. Fit and secure joints with screw and spline, internal reinforcement, or welding.
8. Reinforce members as required to retain fastener threads.
9. Where fasteners are exposed to view from interior, countersink bolt or screw heads and finish to match framing.
10. Weld components before finishing and in concealed locations to greatest extent practicable to minimize distortion.
11. Before shipping, shop assemble, mark, and disassemble components that cannot be permanently shop assembled.

B. Provide continuous aluminum curb with weatherproof expansion joints and locked and sealed or fully welded corners. Locate weep holes in the curb at each rafter connection to drain condensation.

C. Prepare framing to receive anchor and connection devices and fasteners.

D. Metal Protection: As follows:
1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

3. Where aluminum will contact pressure-treated wood, separate dissimilar materials by methods recommended by manufacturer.

2.5 ALUMINUM FINISHES

A. Section 05 08 00 Type 4 to match anodized aluminum appearance, unless otherwise selected by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting skylight performance.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Furnish anchor bolts and inserts for setting in concrete formwork or masonry indicated to support skylights.

B. Metal Protection: As follows:
1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
3. Where aluminum will contact pressure-treated wood, separate dissimilar materials by methods recommended by manufacturer.

3.3 INSTALLATION

A. General: Comply with manufacturer's written instructions for protecting, handling, and installing skylight components.
1. Fit frame joints to produce hairline joints free of burrs and distortion.
2. Rigidly secure non-movement joints.
3. Accommodate thermal and mechanical movements.
4. Install framing components to drain water passing joints and to drain condensation and moisture occurring or migrating within skylight system to the exterior.
5. Coordinate installation of insulation and flashings at skylight perimeters to maintain continuity of thermal and water barriers.
6. Set continuous curbs and flashings in a full sealant bed, unless otherwise indicated. Comply with requirements in Division 7 Section "Joint Sealants."

B. Erection Tolerances: Install skylight components true in plane, accurately aligned, and without warp or rack. Adjust framing to comply with the following tolerances:
1. Variation from Plane: Limit variation from plane or location shown to 1/8 inch in 10 feet (3 mm in 3 m); 1/4 inch (6 mm) over total length.
2. Alignment: Where surfaces abut in line and at corners and where surfaces are separated by less than 3 inches (76 mm), limit offset from true alignment to less than 1/32 inch (0.8 mm); otherwise, limit offset from true alignment to 1/8 inch (3.2 mm).

C. Field Glazing: As follows:
1. Structural Silicone Sealant Glazing: Prepare surfaces that will contact sealant and install sealant according to sealant manufacturer's written instructions. Preparation includes, but is not limited to, cleaning and priming. Mechanically fasten glazing in place until sealant cures. Clean excess sealant from surfaces before sealant cures.
2. Insulating Glass: Comply with requirements in Division 8 Section "Glazing."
3. Plastic Glazing: Comply with requirements in Division 8 Section "Plastic Glazing."

D. Install secondary-sealant weatherseal according to sealant manufacturer's written instructions to provide weatherproof joints. Install joint fillers behind sealant as recommended by sealant manufacturer.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field quality-control tests and to prepare test reports.

B. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field quality-control tests and to prepare test reports.

C. Sealant Adhesion Tests: Test installed sealant in a minimum of two areas and as follows:
   1. Test structural silicone sealant according to field adhesion test method described in AAMA CW 13, "Structural Sealant Glazing Systems (A Design Guide)."
   2. Test weatherseal sealant as recommended in writing by sealant manufacturer.

D. Water-Spray Test: Test skylights for compliance with requirements according to procedures in AAMA 501.2.
   1. Air Infiltration: Test skylights according to AAMA 503, which requires testing according to ASTM E 783.
   2. Static-Air-Pressure Differential: minimum.
   3. Air Leakage: of surface maximum.

E. Water Penetration: Test skylights for compliance with requirements according to AAMA 503, which requires testing according to ASTM E 1105.
   1. Uniform Static-Air-Pressure Difference: 20 percent of positive design wind load, but not less than 6.24 lbf/sq. ft. (300 Pa).

F. Repair or replace Work that does not meet requirements or that is damaged by testing; repair or replace to comply with specifications.

3.5 CLEANING

A. Clean skylights inside and outside, immediately after installation and after sealants have cured, according to manufacturer's written recommendations.
   1. Remove temporary protective coverings and strippable coatings from prefinished metal surfaces. Remove labels and markings from all components.

B. Remove excess sealant according to sealant manufacturer's written recommendations.

END OF SECTION

SECTION 08 68 50 - GLAZED CANOPY ASSEMBLY

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Galvanized steel-framed canopy.
2. Delegated design and engineering of metal framing, glass and glazing.
3. Point supported glass using countersunk rotule fittings.
4. Custom fabrication to design shown.
5. Shop prime coatings.
6. Shop topcoat finishes.

C. Extent:
1. Fabricator engineered, hot dipped galvanized, shop primed, shop topcoated, with tempered laminated glass glazed point supported assembly with integral gutters and downspouts.

D. Related Sections include the following:
1. Division 01 Section "Engineering by Contractor" for delegated design.
2. Division 05 Section for galvanizing.
3. Division 05 Section for shop coatings on galvanizing.
4. Division 09 Section for field painting.
5. Division 8 Section "Glazing" for glass requirements installed in metal-framed canopy.

1.2 PERFORMANCE REQUIREMENTS

A. General: Provide metal-framed canopy capable of withstanding loads and thermal and structural movements indicated without failure. Failure includes the following:
1. Deflection exceeding specified limits.
2. Thermal stresses transferred to the building structure.
3. Framing members transferring stresses, including those caused by thermal and structural movement, to glazing.
4. Noise or vibration created by thermal and structural movement and wind.
5. Loosening or weakening of fasteners, attachments, and other components.
6. Sealant failure.

B. Deflection Limits: As follows:
1. Deflection of the entire length of framing members in direction normal to glazing plane is limited to 1/180 of clear span or 3/4 inch (19 mm), whichever is smaller, unless otherwise indicated.
2. Deflection of the entire length of framing members for spans exceeding 20 feet (6 m) is limited to 1/240 of clear span.
3. Deflection of framing members in a direction parallel to glazing plane, when carrying full dead load, is limited to an amount not exceeding that which reduces glazing bite below 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 (3.2 mm).

C. Lateral Support: Compression flanges of flexural members are laterally braced by cross members with minimum depths equal to 50 percent of flexural member depth and by anchors to the building structure. Glazing material does not provide lateral support.

D. Structural Loads: Provide metal-framed canopy, including anchorage, capable of withstanding the effects of the following design loads when supporting full dead loads:

1. Wind Loads: As indicated on structural documents
2. Snow Loads: As indicated on structural documents.
3. Roof Loads: As follows:
   a. Concentrated Load: 250 lbf (1112 N) applied to framing members at location that produces the most severe stress or deflection.
   b. Live Load: As indicated on structural documents.
4. Seismic Loads: As indicated.

E. Structural Performance: Provide metal-framed canopy, including anchorage, capable of withstanding test pressure indicated without material and deflection failures and permanent deformation of structural members exceeding 0.2 percent of span when tested according to ASTM E 330.
   1. Test Pressure: 150 percent of positive and negative wind-load design pressures.
   2. Test Duration: As required by design wind velocity; fastest 1 mile (1.609 km) of wind for relevant exposure category.

F. Thermal Movement: Provide metal-framed canopy that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, sealant failure, and other detrimental effects.
   1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C) material surfaces.

G. Water Penetration: No water penetration performance shall be required except that in a vertical rain storm not water shall penetrate glazed roof and water shall be drained to gutters and conductor downspouts.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions and profiles of components, and finishes for metal-framed canopy.

B. Shop Drawings: For metal-framed glazed canopy. Include plans, elevations, sections, details, and attachments to other Work.
   1. Include structural analysis data and calculations signed and sealed by the qualified professional engineer responsible for their preparation.
   2. Show analysis of glass design and requirements, including whether or not laminated glass is required.

C. Samples for Initial Selection: Manufacturer's color charts consisting of sections of units showing the full range of colors available for factory-finished aluminum.
   1. Primary members.
   2. Point support components.
   3. Glass, 12 inch square.

F. Installer Certificates: Signed by manufacturer certifying that installers comply with requirements.

G. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer to assume engineering responsibility who has specialized in installing metal-framed canopy similar to those indicated for this Project and who is acceptable to manufacturer.
   1. Engineering Responsibility: Preparation of Shop Drawings, testing program development, test result interpretation, and comprehensive engineering analysis by a qualified professional engineer.

B. 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 canopy that are similar to those indicated for this Project in material, design, and extent.

D. Welding: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code--Aluminum."

1.5 PROJECT CONDITIONS

A. Field Measurements: Where metal-framed canopy are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.6 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of metal-framed canopy that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
1. Structural failures.
2. Sealant failures.
3. Failure of systems to meet performance requirements.
4. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
5. Water leakage; defined as uncontrolled water appearing on normally exposed interior surfaces of canopy from sources other than condensation. Water controlled by flashing and gutters and drained back to the exterior and that cannot damage adjacent materials or finishes is not water leakage.

C. Manufacturer Warranty: Period Provide 10 year warranty for design integrity, weather ability and durability of system components, as noted above.

D. Installer Warranty Period: Warrant installation 5 years for installation and repairs or failures as noted above. Prove written requirements for notification of installer and terms for maintaining warranty provisions in accordance with owner's rights in Division 1 of the specifications.

E. Provide manufacturers and installer's certificates that all work is in accord with approved shop drawings and specifications and is free from defects in materials and workmanship.

PART 2 - PRODUCTS

2.1 AVAILABLE FABRICATORS

A. Subject to specification and drawing requirements, custom fabricators include:
1. Bellwether Design Technologies: http://bellwetherdesigntech.com/products/canopies/.
2. Design Steel Glass; http://designsteelglass.com/.
3. CRLaurence, a division of US Aluminum; http://www.crl-arch.com/.
4. Super Sky Products Enterprises, LLC; http://www.supersky.com/.
5. Oldcastle BuildingEnvelope; www.obe.com/.
6. Approved fabricator.

2.2 FRAMING MATERIALS

A. Metals and fasteners shall conform to the latest edition of the specifications or manufacturer's standards for carbon steel specified in Division 05 and shall comply with A36 steel or stronger:

B. Exposed Flashing, Gutters, Conductors and Closures:
1. Stainless-Steel Sheet: ASTM A 240/A or ASTM A 666, Type 304/Type 316, dead soft, fully annealed; with smooth, flat surface. Provide thicknesses shown, if not as follows:
   a. Not otherwise indicated: 0.019 inch.
   b. Counter flashing, gutters, downspouts, eave, rake, ridge, gravel stops, copings and the like: 0.032 inch.
2. Drips, apron, step, backers: 0.016 inch.
3. Provide stiff, spring temper where required by application such as fascia or gutters requiring rigid face.

4. Exposed sheet metal shall be prime coated in material suitable for proposed field paints.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories; compatible with adjacent materials.
1. Movement Joints: Provide slip-joint linings, spacers, and sleeves of material and type recommended by manufacturer.
2. Retaining-Cap Fasteners: ASTM A 193/A 193M, Series 300 stainless-steel screws; type as recommended by manufacturer.
3. Connections to Supporting Structure: Stainless steel fasteners.
5. Concrete or Masonry Inserts: Zinc-coated cast-iron, malleable-iron, or steel inserts; hot-dip galvanized according to ASTM A 123.

D. Framing-System Gaskets and Joint Fillers: Permanent gaskets and joint fillers for sliding, compression, and nonmoving joints.

E. Framing-System Sealants: Compatible with components with which sealants come in contact and recommended by skylight and sealant manufacturers for this use. Unless otherwise noted, provide clear silicone sealants.

2.3 GLAZING MATERIALS

A. Monolithic Glass: As specified in Division 8 Section "Glazing" And as follows:
1. Glazing: Provide glass type and thickness shown, if not, not less than 0.50 inch thick laminated glass, and tempered and designed to deflect non more than 0.75 inch nor more than 1/180, which ever is less.
2. Laminated glass: Produce using laid-in place interlayer bonded via an autoclave heat and pressure process. Minimum interlayer thickness is to be 0.060". (Poured or cast resin laminates will not be permitted.)
3. Glass shall be tempered to comply with the following:
   a. Tempering: Horizontally tempered, eliminating tong marks.
   b. Edges: Ground flat with a frosted appearance unless otherwise noted.
   c. Fabrication: Edgework, holes and notches in tempered glass panels shall be completed before tempering.

B. Glazing Gaskets: Manufacturer's standard pressure-glazing gaskets of elastomer type and hardness selected by skylight and gasket manufacturers to comply with requirements. Provide gasket assemblies that have corners sealed with sealant recommended by gasket manufacturer.

C. Spacers, Edge Blocks, and Setting Blocks: Manufacturer's standard permanent nonmigrating type of elastomer type and hardness selected to comply with requirements.
1. For structural silicone glazing, provide bond-breaking spacer gaskets and bonding setting blocks compatible with silicone sealants.

D. Structural Silicone Sealant: ASTM C 1184, compatible with components with which sealant comes in contact, formulated and tested for use as a structural sealant, and neutral curing.
1. Color: Black or clear/translucent, as determined by Architect..
2. Tensile Strength: 100 psi (690 kPa) minimum.
3. Provide sealant with modulus of elasticity that will not allow movement of more than 25 percent of joint width, unless less movement is required by skylight systems' design.

E. Weatherseal Sealant: Neutral-curing silicone sealant recommended by skylight and sealant manufacturers for this use.
1. Sealant is capable of withstanding 50 percent movement in both extension and compression (total of 100 percent movement) when tested for adhesion and cohesion under maximum cyclic movement according to ASTM C 719.
2. Sealant complies with ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and, as applicable to substrates including other sealants with which it comes in contact, O.
3. Color: As selected by Architect to include Black.

F. Fittings
1. Point support fittings:

a. Type: Rotule, counter sunk.
b. Configuration: Exterior countersink discs, flush countersunk bolts and articulated swivel bolts with machine finish; socket head bolt will be with hexagonal shank.
c. Material: Stainless Steel Type 316
d. Finish: As approved by architect, to include brushed or 2B with shop applied primer and top coat.

2. The finish of all fittings will be as called for on the architect's drawings or as selected from available options during shop drawing process.
3. Attachment plates shall provide a tolerance capability which will cope with the full range of movements shown on top right:
   a. Thermal movements occurring as a result of differential coefficients of thermal expansion within the range specified. The components used within the system will noiselessly withstand all thermal movements without any buckling, distortion, cracking, failure of joint seals or undue stress on the glass or fixing assemblies.
   b. Deflection of edge beams due to loading applied after erection of the cladding to magnitude specified.
   c. Deflection due to self-weight of the structural glass system.
   d. Inward and outward movements due to the design wind loads specified or indicated on drawings.
4. Bushings: UV-resistant nylon.
5. Gaskets: fully vulcanized fiber, neoprene or pre-cured silicone.

2.4 FABRICATION

A. General: Fabricate work to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage , but not less than that required to support structural loads and the following:
1. Assemble work in the shop to greatest extent possible to minimize field splicing and assembly.
2. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
3. Use connections that maintain structural value of joined pieces.

B. Framing Components: As follows:
1. Fabricate components that, when assembled, will have accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.
2. Fabricate components to drain water passing joints and to drain condensation and moisture occurring or migrating within canopy system to the exterior.
3. Fabricate components to accommodate expansion, contraction, and field adjustment, and to provide for minimum clearance and shimming at canopy perimeter.
4. Fabricate components to ensure that glazing is thermally and physically isolated from framing members.
5. Form shapes with sharp profiles, straight and free of defects or deformations, before finishing.
6. Fit and assemble components to greatest extent practicable before finishing.
7. Fit and secure joints with screw and spline, internal reinforcement, or welding.
8. Reinforce members as required to retain fastener threads.
9. Where fasteners are exposed to view from interior, countersink bolt or screw heads and finish to match framing.
10. 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.
11. Form work true to line and level with accurate angles and surfaces.
    a. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.
12. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
13. Connections: Fabricate work with welded connections unless otherwise indicated.
14. Before shipping, shop assemble, mark, and disassemble components that cannot be permanently shop assembled.

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 welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint.

D. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

E. Prepare framing to receive anchor and connection devices and fasteners.
2. Insulating Glass: Comply with requirements in Division 8 Section "Glazing."
3. Structural Silicone Sealant Glazing: Prepare surfaces that will contact sealant and install sealant according to sealant manufacturer's written instructions. Preparation includes, but is not limited to, cleaning and priming. Mechanically fasten glazing in place until sealant cures. Clean excess sealant from surfaces before sealant cures. Do not transport units until sealant has cured.

2.5 FINISHES.

A. General: Comply with NAAMM “Metal Finishes Manual” treatment and finish recommendations. Surface preparation: Before fabrication clean surfaces of dirt, oil, grease and other contaminants.

B. Corrosion coating: Provide hot dip galvanizing. After fabrication chemically clean units per SSPC-SP 1 and pickle per SSPC-SP 8 and follow with hot-dip galvanizing per ASTM A123.

C. Shop applied primer: Provide a 1.0 mil dry film thickness shop applied finish consisting of a hot-phosphate solution treatment, a chromic-acid rinse, drying and a special dip-metal primer coating and oven drying for 30 minutes or more at 300 degrees F.

D. Stainless steel: if selected by architect provide 2B finish with shop prime coat and shot top finish coat in approved color.

E. Treatment and coating materials shall be equal to the following:
1. Pre-treatment - zinc phosphate.
2. Primer - high performance urethane or epoxy primer.
3. Finish coat - Equal to Tnemec “Ultrathane” acrylic polyurethane.

F. Colors: Provide black, plus manufacturers standard color range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting skylight performance.
1. Follow the recommendations of GANA (Glass Association of North America) as to inspection procedures.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Furnish anchor bolts and inserts for setting in concrete formwork or masonry or steel framework indicated to support canopy.

3.3 INSTALLATION

A. General: Comply with manufacturer's written instructions for protecting, handling, and installing skylight components.
1. Fit frame joints to produce hairline joints free of burrs and distortion.
2. Rigidly secure nonmovement joints.
3. Accommodate thermal and mechanical movements.

4. Install framing components to drain water passing joints and to drain condensation and moisture occurring or migrating within skylight system to the exterior.
5. Coordinate installation of insulation and flashings at skylight perimeters to maintain continuity of thermal and water barriers.
6. Set continuous curbs and flashings in a full sealant bed, unless otherwise indicated. Comply with requirements in Division 7 Section "Joint Sealants."

B. Install in accordance with the glass system provider's requirements and the shop drawings, and comply with the following:
1. Employ only experienced glaziers who have had previous experience with the materials and systems being applied. Use tools and equipment recommended by the manufacturer.
2. Plate-to-plate joints of glass are to be sealed with silicone sealant. Joint dimensions will be designed to be compatible with sealant properties and live load movement of the structure.
3. Bolt torque: torque bolts to torques specified on shop drawings using a calibrated tool. Lock torque bolts into position to prevent back-off. Reset calibrations regularly to ensure an accurate torque.
4. Clean glazing connectors receiving glazing materials of deleterious substances that might impair the work. Remove protective coatings that might fail in adhesion or interfere with the bonding of materials of deleterious substances that might impair the work. Remove protective coatings that might fail in adhesion or interfere with bond of sealants. Comply with the manufacturer's instructions for final wiping of surfaces immediately before the application of primer and glazing sealants. Wipe metal surfaces with an appropriate cleaning agent.
5. Inspect each unit of glass immediately before installation. Glass that has significant impact damage at edges, scratches, abrasion of faces or any other evidence of damage will not be installed.
6. Sealants: prime surfaces are to receive glazing sealants where required, in accordance with the manufacturer's recommendations, using recommended primers.
7. Locate setting blocks, if required by the drawings, at the quarter points of the sill, but no closer than 6 inches to corners of the glass. Use blocks of proper sizes to support the glass in accordance with the manufacturer's recommendations.
8. Provide spacers to separate the glass from attachment plates.
9. Set the glass in a manner that produces the greatest possible degree of uniformity in appearance. Face all glass which has a dissimilar face with matching faces in the same direction.
10. Use masking tape or other suitable protection to limit the coverage of glazing materials on the surfaces intended for sealants.
11. Tool the exposed surfaces of glazing materials.
12. Clean excess sealant from the glass and support members immediately after the application, using solvents or cleaners recommended by the manufacturers.

C. Erection Tolerances: Install skylight components true in plane, accurately aligned, and without warp or rack. Adjust framing to comply with the following tolerances:
1. Variation from Plane: Limit variation from plane or location shown to 1/8 inch in 10 feet (3 mm in 3 m); 1/4 inch (6 mm) over total length.
2. Alignment: Where surfaces abut in line and at corners and where surfaces are separated by less than 3 inches (76 mm), limit offset from true alignment to less than 1/32 inch (0.8 mm); otherwise, limit offset from true alignment to 1/8 inch (3.2 mm).

D. Field Glazing: As follows:
1. Structural Silicone Sealant Glazing: Prepare surfaces that will contact sealant and install sealant according to sealant manufacturer's written instructions. Preparation includes, but is not limited to, cleaning and priming. Mechanically fasten glazing in place until sealant cures. Clean excess sealant from surfaces before sealant cures.
2. Monolithic Glass: Comply with requirements in Division 8 Section "Glazing."

E. Install secondary-sealant weatherseal according to sealant manufacturer's written instructions to provide weatherproof joints. Install joint fillers behind sealant as recommended by sealant manufacturer.

3.4 CLEANING

A. Clean canopy inside and outside, immediately after installation and after sealants have cured, according to manufacturer's written recommendations.
   1. Remove temporary protective coverings and strippable coatings from prefinished metal surfaces. Remove labels and markings from all components.

B. Remove excess sealant according to sealant manufacturer's written recommendations.

C. Glass to be cleaned according to:
   1. GANA Glass Informational Bulletin GANA 01-0300 - Proper Procedures for Cleaning Architectural Glass Products.
   2. GANA Glass Information Bulletin GANA TD-02-0402 – Heat-Treated Glass Surfaces Are Different.

D. Do not use scrapers or other metal tools to clean glass.

END OF SECTION

SECTION 08 71 20 - FIRE DEPARTMENT KEY ACCESS BOX

PART 1 - GENERAL

1.1 SUMMARY

A. Related documents: All of the Contract Documents and provisions, including the Drawings, and Division 1 General Requirements apply to the work of this Section.

B. Provide fire department key access hardware.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide unit acceptable to Owner and local fire department. Where no preferences or standards are indicated provide the units given below

B. High security Commercial Key Access Box:
1. Function/Operations: Hinged door box located at building exterior containing key or access card to permit firefighter to gain building access without breaking lockable openings.
2. Face lock: UL listed Medeco lock keyed to local fire department master key.
3. Surface mount faceplate size: 5 x 4 x 3.25 inch [WxHxD].
4. Recessed faceplate size: 7 x 7 x 3.25 inch [WxHxD]. Provide recessed mounting kit
5. Finish: TGIC powder coat, black.
6. Security option: Where shown, alarm tamper switch.
7. Product: Knox Co. Model 3200
8. Mounting: Recessed mount, unless otherwise indicated.
9. Attachment: Through wall bolts with large steel washers at inside of structural surface.

C. Location: Coordinate with the Owner, Architect and local fire department.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections. Install assemblies complete with all hardware, anchors, inserts, supports and accessories. Test and adjust operation.

B. Restore damaged finishes and test for proper operation. Clean and protect work from damage.

END OF SECTION

SECTION 080671 – DOOR HARDWARE SCHEDULE

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 references specification sections relating to commercial door hardware for the following:

1. Swinging doors.
2. Sliding Doors.
3. Other doors to the extent indicated.

B. Commercial door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical and access control door hardware.
3. Electromechanical and access control door hardware power supplies, back-ups and surge protection.
4. Automatic operators.
5. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Door Hardware”.
2. Division 08 Section “Automatic Door Operators”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. State Building Codes, Local Amendments.

E. Standards: Reference Related Sections for requirements regarding compliance with applicable industry standards.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

a. Type, style, function, size, label, hand, and finish of each door hardware item.
b. Manufacturer of each item.
c. Fastenings and other pertinent information.
d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
e. Explanation of abbreviations, symbols, and codes contained in schedule.
f. Mounting locations for door hardware.
g. Door and frame sizes and materials.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.

D. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.

F. Warranties and Maintenance: Special warranties and maintenance agreements specified in the Related Sections.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.5 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

1.6 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. Refer to “PART 3 – EXECUTION” for required specification sections.

PART 3 - EXECUTION

3.1 DOOR HARDWARE SETS

A. The door hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.

2. The supplier is responsible for handing and sizing all products.

3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Products listed in the hardware sets shall be supplied by and in accordance with the requirements described in the specification section as noted for each item.

1. Section 08 71 00 – Door Hardware.
2. Section 08 71 13 – Automatic Door Operators.

C. Manufacturer’s Abbreviations:

1. MK - McKinney
2. PE - Pemko
3. SU - Securitron
4. RO - Rockwood
5. AD - Adams Rite
6. SA - SARGENT
7. RF - Rixson
8. NO - Norton
9. OT - Other

Hardware Sets

Set: 1.0

Doors: X102

1 Continuous Hinge	CFM_SLF-HD1 PT x Length	PE 087100

	Required				
1 Electric Power Transfer	EL-CEPT		SU	087100	⚡
1 Rim Exit Device, Exit Only	43 56 AD8510 EO	US32D	SA	087100	⚡
1 Automatic Opener	6000 Series RF	689	NO	087100	⚡
1 ElectroLynx Harness - Frame	QC-C1500P		MK	087100	⚡
1 ElectroLynx Harness - Door	QC-CXXX (Size as required)		MK	087100	⚡
1 Door Switch	502		NO	087100	⚡
1 Power Supply	AQL4-R8EL		SU	087100	⚡
1 Wiring Diagram	Elevation and Point to Point as Specified		OT		

Notes: Operation:
*Door normally closed and secured. *Exit only - no re-entry
*Activation of wall switch on "non" secure side to activate automatic operator.
*Upon loss of power door to remain locked.
* Always free egress.

Set: 2.0

Doors: X101

1 Continuous Hinge	CFM_SLF-HD1 PT x Length Required		PE	087100	
1 Electric Power Transfer	EL-CEPT		SU	087100	⚡
1 Rim Exit Device, Passage	43 56 AD8515 ETB	US32D	SA	087100	⚡
1 Automatic Opener	6000 Series RF	689	NO	087100	⚡
1 ElectroLynx Harness - Frame	QC-C1500P		MK	087100	⚡
1 ElectroLynx Harness - Door	QC-CXXX (Size as required)		MK	087100	⚡
2 Door Switch	502		NO	087100	⚡
1 Power Supply	AQL4-R8EL		SU	087100	⚡
1 Wiring Diagram	Elevation and Point to Point as Specified		OT		

Notes: Operation:
* Door normally closed and unlocked.
*Activation of wall switch either side to activate automatic operator.
* Upon loss of power door to remain unlocked.
*Always free egress.

Set: 3.0

Doors: UX102, X103, X104, X105, X107, X108, X109, X110, X111

1 Continuous Hinge	CFM_HD1 x Length Required		PE	087100	

1	Storeroom/Closet Lock	DG263 DG264 8204 LNB	US32D	SA 087100	
1	Surface Closer	351 UO	EN	SA 087100	
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO 087100	
1	Gasketing	303AS (Head & Jambs)		PE 087100	
1	Sweep	18061CNB		PE 087100	

Set: 4.0

Doors: 101A, 101B

1	Continuous Hinge	CFM_HD1 PT x Length Required		PE 087100	
1	Electric Power Transfer	EL-CEPT		SU 087100	⚡
1	Rim Exit Device	DG263 DG264 16 43 56 AD8506 ETB	US32D	SA 087100	⚡
1	Automatic Opener	6311	689	NO 087113	⚡
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO 087100	
3	Silencer	608		RO 087100	
1	ElectroLynx Harness - Frame	QC-C1500P		MK 087100	⚡
1	ElectroLynx Harness - Door	QC-CXXX (Size as required)		MK 087100	⚡
2	Door Switch	502		NO 087100	⚡
1	Power Supply	AQL4-R8EL		SU 087100	⚡
1	Wiring Diagram	Elevation and Point to Point as Specified		OT	

Notes: Operation:
*Door normally closed and secured.
*During business hours door to be mechanically opened and dogged down in the push/pull position.
*Activation of wall switch on either side to activate automatic operator.
*Upon loss of power door to remain in locked/unlocked state
* Always free egress.
*After business hours door operator to be controlled through the access control system. Exit device to be undogged to be securely locked and closed.

Set: 5.0

Doors: 107A, 107B, 108A, 108B, 109, 110, 110A, 111, 111A, 112, 112A, 113, 113A, 113C, 114, 114A, 115, 115A, 116, 116A, 122, 123, 136, 137, 140, 162, 166, 167, 169

1	Continuous Hinge	CFM_HD1 x Length Required		PE 087100	
1	Mortise Lock	2190 1- 02-Round	US32D	AD 087100	
1	Mortise Cylinder	DG2 - As Required	US32D	SA 087100	
1	Surface Closer	351 UO	EN	SA 087100	
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO 087100	

Set: 6.0

Doors: 138

2	Push Plate	70C-RKW	US32D	RO	087100
1	Concealed Closer	608EL / SL	626	RF	087100

Set: 7.0

Doors: U105, U106, U107

6	Hinge, Full Mortise	TA2714 [NRP]	US26D	MK	087100
1	Dust Proof Strike	570	US26D	RO	087100
1	Self Latch Flush Bolt Set	2845 / 2945 (as required)	US26D	RO	087100
1	Storeroom/Closet Lock	DG263 DG264 8204 LNB	US32D	SA	087100
1	Surf Overhead Stop	10-X36	630	RF	087100
1	Surface Closer	351 CPS	EN	SA	087100
2	Silencer	608		RO	087100

Set: 8.0

Doors: 129, U108

3	Hinge, Full Mortise	TA2714 [NRP]	US26D	MK	087100
1	Storeroom/Closet Lock	DG263 DG264 8204 LNB	US32D	SA	087100
1	Surface Closer	351 UO	EN	SA	087100
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO	087100
3	Silencer	608		RO	087100

Set: 9.0

Doors: 127, 148

3	Hinge, Full Mortise	TA2714 [NRP]	US26D	MK	087100
1	Storeroom/Closet Lock	DG263 DG264 8204 LNB	US32D	SA	087100
1	Surface Closer	351 CPS	EN	SA	087100
3	Silencer	608		RO	087100

Set: 10.0

Doors: 130

3	Hinge, Full Mortise, Hvy Wt	T4A3786 [NRP]	US26D	MK	087100
1	Storeroom/Closet Lock	DG263 DG264 8204 LNB	US32D	SA	087100
1	Surface Closer	351 CPS	EN	SA	087100
1	Threshold	to architect detail		PE	087100
1	Gasketing	S88BL		PE	087100
1	Door Bottom	411APKL		PE	087100

Set: 11.0

Doors: 168

3	Hinge, Full Mortise	TA2714 [NRP]	US26D	MK 087100
1	Office/Entry Lock	DG263 DG264 8205 LNB	US32D	SA 087100
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO 087100
3	Silencer	608		RO 087100

Set: 12.0

Doors: 131, 143, 144B, 144C

6	Hinge, Full Mortise	TA2714 [NRP]	US26D	MK 087100
1	Dust Proof Strike	570	US26D	RO 087100
1	Self Latch Flush Bolt Set	2845 / 2945 (as required)	US26D	RO 087100
1	Classroom Lock	DG263 DG264 8237 LNB	US32D	SA 087100
2	Surf Overhead Stop	10-X36	630	RF 087100
2	Silencer	608		RO 087100

Set: 13.0

Doors: 104, 121, 132, 134, 142, 155, 175, 177, 178A, 178B, 179A, 179B, 183A, 183B

3	Hinge, Full Mortise	TA2714 [NRP]	US26D	MK 087100
1	Classroom Lock	DG263 DG264 8237 LNB	US32D	SA 087100
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO 087100
3	Silencer	608		RO 087100

Set: 14.0

Doors: 125, 126, 145, 152, C102, C104, C107A, C112A, C113

3	Hinge, Full Mortise	TA2714 [NRP]	US26D	MK 087100
1	Classroom Lock	DG263 DG264 8237 LNB	US32D	SA 087100
1	Surface Closer	351 UO	EN	SA 087100
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO 087100
3	Silencer	608		RO 087100

Set: 15.0

Doors: 119

6	Hinge, Full Mortise	TA2714 [NRP]	US26D	MK 087100
2	Single Dummy Trim	8295 LNB	US32D	SA 087100
2	Roller Latch	594	US26D	RO 087100
2	Surf Overhead Stop	10-X36	630	RF 087100

Set: 16.0

Doors: 105, 153, 154, U104

3	Hinge, Full Mortise	TA2714 [NRP]	US26D	MK 087100
1	Privacy Lock	V21 8265 LNB	US32D	SA 087100
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO 087100
3	Silencer	608		RO 087100

Set: 17.0

Doors: 117, 118, 133, 135, 149A, 149B, 150, 151, 158, 159, 165, 170, 172, 173, 174, 176, 180

3	Hinge, Full Mortise	TA2714 [NRP]	US26D	MK 087100
1	Passage Latch	8215 LNB	US32D	SA 087100
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO 087100
3	Silencer	608		RO 087100

Set: 18.0

Doors: 144A, 156, 160, 171, 182

3	Hinge, Full Mortise	TA2714 [NRP]	US26D	MK 087100
1	Passage Latch	8215 LNB	US32D	SA 087100
1	Surf Overhead Stop	10-X36	630	RF 087100
3	Silencer	608		RO 087100

Set: 19.0

Doors: 106, 124, C105, C107, C110, C111, C112B

3	Hinge, Full Mortise	TA2714 [NRP]	US26D	MK 087100
1	Passage Latch	8215 LNB	US32D	SA 087100
1	Surface Closer	351 UO	EN	SA 087100
1	Wall Stop	403 (or) 441CU (As Required)	US26D	RO 087100
3	Silencer	608		RO 087100

Set: 20.0

Doors: 139

1	Mortise Cylinder	DG2 - As Required	US32D	SA 087100

Notes: Balance of hardware by opening provider

Set: 21.0

Doors: UX101, X106

2	Continuous Hinge	CFM_HD1 x Length Required		PE 087100

1	Surface Vert Rod Exit	DG263 DG264 43 8710 306 x 863	US32D	SA	087100
1	Surface Vert Rod Exit, Exit Only	43 8710 EO	US32D	SA	087100
2	Surface Closer	351 CPS	EN	SA	087100
1	Threshold	to architect detail		PE	087100
1	Gasketing	303AS (Head & Jambs)		PE	087100
2	Door Bottom	411APKL		PE	087100

Set: 22.0

Doors: C108, C109

1	Mortise Cylinder	DG2 - As Required	US32D	SA	087100

END OF SECTION 080671

SECTION 087100 - DOOR HARDWARE

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 commercial door hardware for the following:

1. Swinging doors.
2. Sliding doors.
3. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware.
3. Automatic operators.
4. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Hollow Metal Doors and Frames”.
2. Division 08 Section “Aluminum-Framed Entrances and Storefronts”.
3. Division 08 Section “Automatic Door Operators”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. UL/ULC and CSA C22.2 - Standards for Automatic Door Operators Used on Fire and Smoke Barrier Doors and Systems of Doors.
8. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:

1. ANSI/BHMA Certified Product Standards - A156 Series.
2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

   a. Type, style, function, size, label, hand, and finish of each door hardware item.
   b. Manufacturer of each item.
   c. Fastenings and other pertinent information.
   d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
   e. Explanation of abbreviations, symbols, and codes contained in schedule.
   f. Mounting locations for door hardware.
   g. Door and frame sizes and materials.
   h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

    a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
    b. Complete (risers, point-to-point) access control system block wiring diagrams.
    c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

E. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity.

Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:

1. Ten years for mortise locks and latches.
2. Five years for exit hardware.

3. Twenty five years for manual overhead door closer bodies.
4. Five years for motorized electric latch retraction exit devices.
5. Two years for electromechanical door hardware, unless noted otherwise.

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

a. Two Hinges: For doors with heights up to 60 inches.
b. Three Hinges: For doors with heights 61 to 90 inches.
c. Four Hinges: For doors with heights 91 to 120 inches.
d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:

a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

5. Manufacturers:

a. Bommer Industries (BO).
b. Hager Companies (HA).
c. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).

B. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 certified continuous geared hinge. with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Manufacturers:

a. Bommer Industries (BO).
b. Hager Companies (HA).
c. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).

2.3 POWER TRANSFER DEVICES

A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

a. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE) - EL-CEPT Series.
b. Securitron (SU) - EL-CEPT Series.
c. Von Duprin (VD) - EPT-10 Series.

B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:

   a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - Electrical Connecting Kit: QC-R001.
   b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - Connector Hand Tool: QC-R003.

2. Manufacturers:

   a. Hager Companies (HA) - Quick Connect.
   b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK) - QC-C Series.

2.4 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.
3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.

5. Manufacturers:

   a. Burns Manufacturing (BU).
   b. Door Controls International (DC).
   c. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).

B. Door Push Plates and Pulls: ANSI/BHMA A156.6 certified door pushes and pulls of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.

3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
5. Manufacturers:
    a. Burns Manufacturing (BU).
    b. Hiawatha, Inc. (HI).
    c. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).

2.5 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.

C. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:

1. Threaded mortise cylinders with rings and cams to suit hardware application.
2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
4. Tubular deadlocks and other auxiliary locks.
5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
6. Keyway: Manufacturer’s Standard.

D. Security Cylinders: ANSI/BHMA A156.5, Grade 1 Certified Products Directory (CPD) listed security cylinders and keys able to be used together under the same facility master or grandmaster key system. Cylinders to be factory keyed.

1. New security key systems shall not be established with products that have an expired patent. Expired systems shall only be specified and supplied to support existing systems.
2. Manufacturers:
    a. Corbin Russwin (RU) - Access 3 AS.
    b. Sargent (SA) - Degree DG2.
    c. Schlage (SC) - Primus Everest.

E. Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.

2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
3. New System: Key locks to a new key system as directed by the Owner.

F. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Three (3).
2. Master Keys (per Master Key Level/Group): Five (5).
3. Construction Keys (where required): Ten (10).
4. Construction Control Keys (where required): Two (2).
5. Permanent Control Keys (where required): Two (2).

G. Construction Keying: Provide temporary keyed construction cores.

H. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.6 KEY CONTROL

A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.

1. Manufacturers:

a. Lund Equipment (LU).
b. MMF Industries (MM).
c. Telkee (TK).

2.7 MECHANICAL LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.

1. Where specified, provide status indicators with highly reflective color and wording for “locked/unlocked” or “vacant/occupied” with custom wording options if required. Indicator to be located above the cylinder with the inside thumb-turn not blocking the visibility of the indicator status. Indicator window size to be a minimum of 2.1” x 0.6” with a curved design allowing a 180 degree viewing angle with protective covering to prevent tampering.

2. Manufacturers:

a. Corbin Russwin Hardware (RU) - ML2000 Series.
b. Sargent Manufacturing (SA) - 8200 Series.
c. Schlage (SC) - L9000 Series.

2.8 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

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: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.9 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.

2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer’s catalog and template book for specific requirements.

3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.

4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.

5. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.

    a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
    b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

6. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.

7. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2” wide stiles.

8. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.

9. Rail Sizing: Provide exit device rails factory sized for proper door width application.

10. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.

1. Manufacturers:

    a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
    b. Sargent Manufacturing (SA) - 80 Series.
    c. dormakaba Precision (PR) - Apex 2000 Series.

2.10 ELECTROMECHANICAL EXIT DEVICES

A. Electromechanical Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed panic and fire exit hardware devices subject to same compliance standards and requirements as mechanical exit devices. Electrified exit devices to be of type and design as specified below and in the hardware sets.

1. Energy Efficient Design: Provide devices which have a holding current draw of 15mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.

2. Where conventional power supplies are not sufficient, include any specific controllers required to provide the proper inrush current.

3. Motorized Electric Latch Retraction: Devices with an electric latch retraction feature must use motors which have a maximum current draw of 600mA. Solenoid driven latch retraction is not acceptable.

4. Manufacturers:

    a. Corbin Russwin Hardware (RU) - ED5000 Series.
    b. dormakaba Precision (PR) - Apex 2000 Series.
    c. Sargent Manufacturing (SA) - 80 Series.

2.11 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.

2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.

3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.

4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.

5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.

6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.

1. Manufacturers:

    a. Corbin Russwin Hardware (RU) - DC6000 Series.
    b. Norton Door Controls (NO) - 7500 Series.
    c. Sargent Manufacturing (SA) - 351 Series.

2.12 ELECTROHYDRAULIC DOOR OPERATORS

A. General: Provide low energy operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for compliance with UL 325. Coordinate operator mechanisms with door operation, hinges, and activation devices.

1. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.

B. Standard: Certified ANSI/BHMA A156.19.

C. Performance Requirements:

1. Opening Force if Power Fails: Not more than 15 lbf required to release a latch if provided, not more than 30 lbf required to manually set door in motion, and not more than 15 lbf required to fully open door.
2. Entrapment Protection: Not more than 15 lbf required to prevent stopped door from closing or opening.

D. Configuration: Surface mounted or in-ground as required. Door operators to control single swinging and pair of swinging doors.

E. Operation: Power opening and spring closing operation capable of meeting ANSI A117.1 accessibility guideline. Provide time delay for door to remain open before initiating closing cycle as required by ANSI/BHMA A156.19. When not in automatic mode, door operator to function as manual door closer with fully adjustable opening and closing forces, with or without electrical power.

F. Features: Operator units to have full feature adjustments for door opening and closing force and speed, backcheck, motor assist acceleration from 0 to 30 seconds, time delay, vestibule interface delay, obstruction recycle, and hold open time from 0 up to 30 seconds.

G. Provide outputs and relays on board the operator to allow for coordination of exit device latch retraction, electric strikes, magnetic locks, card readers, safety and motion sensors and specified auxiliary contacts.

H. Brackets and Reinforcements: Manufacturer's standard, fabricated from aluminum with nonferrous shims for aligning system components.

I. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Norton Door Controls (NO) - 6000 Series.

2.13 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:

a. Burns Manufacturing (BU).
b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
c. Trimco (TC).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:

a. Rixson Door Controls (RF).
b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
c. Sargent Manufacturing (SA).

2.14 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

1. National Guard Products (NG).
2. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).
3. Reese Enterprises, Inc. (RE).

2.15 ELECTRONIC ACCESSORIES

A. Intelligent Switching Power Supplies: Provide power supplies with single, dual or multi-voltage configurations at 12 and/or 24VDC. Power Supply shall have battery backup function with an integrated battery charging circuit. The power supply shall have a standard, integrated Fire Alarm Interface (FAI). The power supply shall provide capability for secondary voltage, power distribution, direct lock control and network monitoring through add on modules. The power supply shall be expandable up to 16 individually protected outputs. Output modules shall provide individually protected, continuous outputs and/or individually protected, relay controlled outputs. Network modules shall provide remote monitoring functions such as status reporting, fault reporting and information logging.

1. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.

2. Manufacturers:

a. Securitron (SU) - AQL Series.

2.16 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.17 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and 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 specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.5 ADJUSTING

A. Initial Adjustment: 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.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.

2. The supplier is responsible for handing and sizing all products.

3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Refer to Section 080671, Door Hardware Sets, for hardware sets.

END OF SECTION 087100

SECTION 08 80 10 - EXTERIOR GLASS

PART 1 GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Exterior glass and glazing.

C. Related sections:
1. Division 08 00 00 – Door and window openings which are not factory glazed; refer to table of contents for required sections.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.

C. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.

D. Warranty: Submit manufacturer's standard warranty. Include labor and materials to repair or replace defective materials.
1. Laminated Glass: Manufacturer's 5-year warranty.
2. Coated Glass: Manufacturer's 10-year warranty.
3. Insulating Glass: Manufacturer's 10-year warranty.

E. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Glazing for Fire-Rated Assemblies: Glazing for assemblies that comply with NFPA 80.

C. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201 and, for wired glass, ANSI Z97.1.

D. Glazing Publications:
1. GANA Publications: GANA's “Glazing Manual.” and “Laminated Glass Design Guide.”
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, “Sloped Glazing Guidelines.”
4. IGMA Publication for Insulating Glass: SIGMA TM-3000, “Glazing Guidelines for Sealed Insulating Glass Units.”

E. Structural and seismic performance: Comply with applicable requirements of ASCE/SEI 7-10 [American Society of Civil Engineers / Structural Engineering Institute] and its “Minimum Design Loads for Buildings & Other Structures” and requirements of authorities having jurisdiction.

F. Mock-Ups: Provide mock-up as required to demonstrate quality of workmanship.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products from the following:
1. Guardian
2. Oldcastle
3. Cardinal IG
4. Pilkington
5. Viracon
6. Approved equal.

B. Basis of design: Low E coating Guardian Sunguard SNX 62/27 (surface #2)

2.2 MATERIALS

A. General: Glass shall comply with ASTM C - 1036 latest unless otherwise specified. Type and thickness as shown or specified.

B. Float Glass: Type I, Class 1, Quality q3, thickness as required by code or for strength with 1/4" minimum, unless otherwise noted or scheduled.

C. Laminated Glass: Clear, plain, heat strengthened or fully tempered laminated regular and safety glass with polyvinyl butyral [PVB] interlayer.. Unless otherwise required by building and life safety codes, provide standard flat ASTM 1036 float glass for laminating. Unless otherwise shown, provide 0.25 inch thick units.

D. Laminated Glass:
1. Standard: Comply with ASTM C 1172.
2. Material: Clear, plain, heat strengthened or fully tempered laminated regular and safety glass with polyvinyl butyral [PVB] interlayer.
3. Characteristics: Materials having a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
4. Type: Unless otherwise required by building and life safety codes, provide standard flat ASTM 1036 float glass for laminating.
5. Thickness: Unless otherwise shown, or required by fabricator structural calculation, provide 0.25 inch thick units.
6. Color & pattern: Where shown on drawings, provide units with frosted or colored interlayer in patterns or extent shown.

E. Tempered Glass: Glass for Tempering: Float, Type I, Class 1, Quality q4
1. Sizes and Cutting: Prior to tempering or heat strengthening, cut glass to required sizes as determined by accurate measurement of openings to be glazed, making allowance for required edge clearances. Cut and process edges in accordance with glass manufacturer's recommendations. Do not cut or treat edges in the field. Thickness: as required by code but 3/16"" minimum.
2. Standard: Provide glass complying with ASTM C - 1036 latest and meeting the requirements of ANSI Z97.1. Wherever possible locate tong marks along an edge which will be concealed in the glazing system. Do not exceed maximum warpage in any direction as listed in the latest printed literature of glass manufacturer.
3. Heat soak tempered glass.
4. Provide safety labeling.

A. Type: Insulating spandrel glass units, tempered laminated at locations as required by Code.

B. Type: High-performance insulating glass units with low-e coating, tempered at locations as required by code and as follows:
1. Sizes as required.
2. Bite: Minimum 1/2 in. bite to perimeter frame,
3. Thickness: 1 inch overall and as follows:
   a. 0.25 inch inner pane.
   b. 0.50 inch airspace x Argon filled.
   c. 0.25 inch outer pane.

C. Color/Tint: As selected.

D. Vision, reflective, color-enriched, Low E glass, tint and performance shall match characteristics of basis of design glass indicated below:

5. Product Series: SunGuard SuperNeutral Low-E.
6. Coating: SunGuard SNX 62/27 (#2) [coating on no. 2 surface].
7. Outboard Substrate: Clear
8. Inboard Substrate: Clear
9. Exterior Appearance: Clear
10. Performance Values: As given below.
11. Transmission:
    a. Visible Light Transmission: 62%
    b. UV Transmission: 06%
    c. Solar Energy Transmission: 23%
12. Reflectivity:
    a. Visible Light Out Reflectivity: 11&
    b. Visible Light In Reflectivity: 12%
    c. Solar Energy Reflectivity: 41%
13. U-Value
    a. Winter Nighttime / Argon: 0.24
    b. Winter Nighttime / Air : 0.29
    c. Summer Daytime / Air: 0.27
14. Heat Gain
    a. Relative Heat Gain: 65
    b. Shading Coefficient: 0.31
    c. Solar Heat Gain Coefficient: 0.27
    d. Light-to-Solar Gain: 2.32

E. Insulating glass seal: Provide a hermetic seal complying with the following:

1. Materials: Butyl primary and silicone secondary seal.
2. Configuration: Uniform and continuous.
3. Secondary seal:
    a. Extend from exterior face of inner glass pane to interior face of exterior glass pane.
    b. Free of contaminants or imperfections specified at primary seal
4. Primary seal:
    a. Free of fingerprints, dirt, debris or materials affecting seal adhesion or continuity.
    b. Not reduced to less than 1/8 in. in width at any point along insulating glass perimeter of the insulating glass unit nor 1/32 in. in thickness
    c. Side of spacer: Not visible through "transparent" layer of thin primary seal.
    d. Free of voids and continuously bonded to glass surface.
5. Insulating glass spacer:
    a. Warm edge type.
    b. Dessicant: grey, 3 sided moisture barrier.
    c. Polycarbonate spacer element.
    d. Color: Architect approved color.
    e. Acceptable products:
        .1) Viracon: Viracon Thermal Space VTS.
        .2) Technoform: TGI Spacer M.
        .3) Thermoseal Group: Thermoflex Spacer

F. Spandrel / Coated Glass (SPG):
Ceramic coated spandrel glass: ASTM C1048, Condition B - spandrel glass, one surface coated; Type 1-transparent glass flat; Quality Q3 – glazing select and coated with ceramic frit.

1. Strength: Tempered or heat-strengthened as required by design criteria and fabricator calculations. Provide safety labeling.
2. Glass type: As shown, if not, tinted float, color as selected.
3. Tint colors: As shown, if not, as selected.

4. Opacifying coating: Manufacturer standard baked on ceramic frit coating in solid or pattern as shown on drawings. Unless otherwise indicated provide frit on 3rd surface of insulated units.
5. Colors: As selected.

G. Glazing Materials:
1. Glazing Tapes: Preformed butyl-based elastomeric tape with 100% solids content. Nonstaining, with or without spacer rod, with release paper backing.
2. Glazing Sealants: One-part silicone, chemically compatible with other sealants and gaskets in the glazing system; Dow 795 Silicone Building Sealant, color to be selected from manufacturer's full range. Other products may be submitted for approval.
3. Compression gaskets: Type required by application.
4. Preformed glazing assemblies: Provide pre-engineered transition assemblies of silicone integrated units to be attached to window, storefront and curtain wall assemblies to create durable seal and connection. Install and attach as recommended by manufacturer.
   a. Acceptable products: Dow STS or Pecora Silspan.

H. Setting blocks, spacers:
1. Setting Blocks: silicone-compatible, 4 in. long by minimum 3/16 in. thick, 1/8 in. narrower than glazing pocket width, 80-90 Shore A Durometer.
2. Anti-Walk Blocks: silicone-compatible, 4 in. long, thickness to be 1/8 in. narrower than the space between the glass and vertical mullion, 50-70 Shore A Durometer.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean glazing channels, stops and rabbets to receive glazing, materials of obstructions and deleterious substances which might impair the work. Remove protective coatings which might interfere with bond of sealants. Comply with manufacturer's instructions for final wiping of surfaces immediately before application of primer and glazing compounds or tapes.

B. Prime surfaces to receive glazing compounds in accordance with manufacturer's recommendations.

3.2 INSTALLATION

A. Standards: Unless otherwise shown or specified, comply with recommendations and requirements of the FGMA "Glazing Sealing Systems Manual" and "Glazing Manual". For the installation of tinted glass comply with glass manufacturer's recommendations.

B. Performance: The installation of each light of exterior glass shall be watertight, airtight, and capable of withstanding temperature changes, wind loading and impact from operation (doors) without failure of any kind including loss or breakage of glass, failure of seal, exudation of sealant and excessive deterioration of glazing materials.

C. Inspect each piece of glass immediately before installation. Do not install any pieces which are improperly sized or have damaged edges, scratches or abrasion or other evidence of damage. Remove labels from glass immediately after installation.

D. Locate setting blocks at sill one-quarter of the width in from each end of the glass, unless otherwise recommended by the glass manufacturer. Use blocks of proper size to support the glass in accordance with manufacturer's recommendations.

E. Provide face shims for all glass sizes larger than 50 united in., to separate glass from stops, except where continuous glazing gaskets or felts are provided. Locate face shims no farther than 24 in. apart and closer than 12 in. to a corner. Place face shims opposite one another. Make bite of spacer on glass a nominal dimension equal to or greater than that required by the manufacturer.

F. Provide edge blocks, located in glazing rabbet as recommended by the glass manufacturer, to insure against displacement of the glass and against metal to glass contact within the rebate and to ensure permanently adequate bite of the glass within the glazing system.

G. Set glass in a manner which produces greatest possible degree of uniformity in appearance.

H. Do not use 2 different glazing materials in the same joint system unless the manufacturer of each material has stated in writing that his material is fully compatible with the other material.

I. Use suitable protection to limit coverage of glazing materials to the surfaces intended for sealants.

J. Butt or lap ends of tapes in accordance with manufacturer's recommendations.

K. Tool exposed surfaces of glazing materials to provide a slight wash away from the glass. Install exposed tapes and gaskets with a slight protrusion above stops in the final compressed condition.

L. Glaze corners and glass to glass joints with clear tooled silicone.

M. Set insulating glass units with void between edge of units and glazing channel. Do not glaze insulating glass units with glazing compounds which might have a deleterious effect on the hermetic seal of the units.
1. Set insulating glass units which have one sheet of heat absorbing, tinted or coated glass with clear glass sheet faced to the interior.

N. Comply with reference standards and the following:
1. Do not glaze units when ambient air temperature is below 40°F or in presence of moisture.
2. Keep glazing rabbet clean and dry during glass installation.
3. Do not allow glass to touch framing system.
4. Inspect each lite of glass prior to installation.
5. Replace chipped or scratched glass.
6. Use suction cups to move lites of glass.
7. Use a "rolling block" to rotate glass.
8. Set glass so s centered in glazing pocket. Provide at least 1/8 inch clearance between sides of glass and vertical frame members, and there is at least
9. Provide at least 1/2 inch bite on glass by exterior stops.
10. Remove labels from glass.

3.3 PROTECTION

A. Protect glass lites from accidental breakage by installing crossed streamers in front of all glass immediately after completion of glazing work.

B. Do not apply markers or tape of any kind to glass surface.

3.4 FIELD QUALITY CONTROL

A. After completion of the first installation of each exterior glazing type and nominal curing of sealants and glazing compounds, test installation for water leaks. Using ordinary city water pressure and a 3/4 inch hose, start applying water at base of glazing and move to upper part checking for leaks as test progresses. Correct any deficiencies observed as a result of test. Test shall be done in the presence of the Architect and glazing system manufacturer's representative.

3.5 CLEAN UP

A. Remove all labels, excess glazing compound and sealants from glass. Clean smudges and smears caused by the work of this Section from adjacent finishes and materials.

B. Repair or replace materials or finishes damaged by the work of this Section.

C. Remove from job site all glass crates and packaging. Remove all broken glass and properly dispose. Leave work areas neat and clean.

END OF SECTION

SECTION 08 80 20 – INTERIOR GLASS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section Includes, without limitation, providing:
1. Glass and glazing for interiors.

C. Extent, without limitation, includes:
1. Borrowed lights, sidelights, interior clerestories, and transoms not connected to exterior.

1.2 SUBMITTALS

A. Comply with Division 01 General Requirements and submit for approval:
1. Product Data: Manufacturer's literature including installation instructions, use restrictions and limitations.
   a. Statement that each product to be furnished is recommended for the application shown.
   b. Complete instructions for handling, storage, mixing, priming, installation, curing and protection of each type of glazing sealant and gasket.
2. Shop drawings: Large scale drawings for fabrication, installation and erections including plans, elevations, details, anchorages, connections and accessories along with sill and joining details and component lengths. Provide templates for work installed by others.
   a. Show representative glazing and glass sizes, thickness and details
   b. Field Measurements: Take accurate field measurements before fabrication and indicate same on shop drawings.
3. Samples: Color and material ranges showing variation of color and finish, if any.
4. Maintenance Data: Provide recommended maintenance procedures.
5. Certification: Certify submitted materials comply with requirements.

B. Shop drawings: Show representative glazing and glass sizes, thickness and details

C. Submit certificates of compliance with fabrication and test requirements, signed by authorized representative of the glass manufacturer(s).

D. Submit structural calculations/tables noting thicknesses, allowable loads and maximum area for each type of glazing specified.

E. Samples: Submit 12" x 12" minimum size samples of each type of glass, glazing sealant and gasket. Provide sealant samples 12 in. long installed between samples of the materials to be glazed, fully cured. Samples will be reviewed for color and texture only. Compliance with all other requirements is the responsibility of the Contractor and Manufacturer.

F. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Comply with Division 01 requirements and governing codes and regulations.

A. Glass Labels: Provide only glass bearing manufacturer's labels certifying thickness, quality, manufacturer and ASTM/Fed Spec compliance.

B. Workmanship Standard: Glazing work shall comply with applicable recommendations of the Flat Glass Manufacturer's Association "Glazing Manual" and "Glazing Sealing Systems Manual".

C. Glazing for Fire-Rated Assemblies: Glazing for assemblies that comply with NFPA 80.

D. Glazing Publications:
1. GANA Publications: GANA's "Glazing Manual." and "Laminated Glass Design Guide."

E. Standards: Comply with ANSI Z97.1 and CPSC 16 CFR 1201. In case of conflict, apply the more stringent provision

F. The installer (sub-contractor) shall be approved by the manufacturer and shall have been successfully installing large glass lites for a period of at least three (3) years.

B. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for 5 years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

1.2 GUARANTEES AND CERTIFICATIONS

A. Provide written warranties signed by the manufacturer, agreeing to repair or replace work which exhibits defects in materials or workmanship for the following periods noted. “Defects” is defined to include, without limitation, leakage of water, abnormal aging or deterioration, edge separation or delamination of laminated glass, peeling, cracking, crazing or other failures of metallic coating in coated glass and failure to meet requirements of contract documents. Provide warranty period indicated with manufacturer.

B. Guarantee for all other glass shall be for a period of 5 years from date of substantial completion. Guarantee shall cover breakage or failure due to imperfections in manufacturing or faulty installation.

C. Warranty: Submit manufacturer's standard warranty. Include labor and materials to repair or replace defective materials.
1. Laminated Glass: Manufacturer's 5-year warranty.
2. Coated Glass: Manufacturer's 10-year warranty.

1.3 PRODUCT DELIVERY AND STORAGE

A. Deliver glazing materials to Project site in manufacturers' unopened containers, fully identified with trade name, color, size, hardness, type, class, and grade. Store each item in accordance with manufacturer's instructions.

B. Deliver and store glass in accordance with manufacturer's and F.G.M.A. recommendations, protected from weather, staining, damage and loss. During storage and handling of glass provide cushions at edge to prevent impact damage. Protect faces from scratches and abrasion.

1.4 JOB CONDITIONS

A. Comply with the following:
1. Do not perform glazing operations when temperature is below 40 degrees F., unless the manufacturer of the glazing materials specifically recommends application of his materials at lower temperatures.
2. If job progress or other conditions require glazing work when temperatures are below 40 degrees F. (or below the minimum temperature recommended by the manufacturer), consult the manufacturer and establish the minimum provisions required to ensure satisfactory work.
3. Record in writing to the manufacturer, with copy to the Architect the conditions under which such glazing work was performed and the provisions made to ensure satisfactory work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturers and fabricators, subject to compliance with requirements, include:
1. Pilkington.
2. Vitro formerly PPG Industries, Inc, glass division.
3. Viracon.
4. Approved equal.

B. The above manufacturers shall be considered as a standard. The sub-contractor may submit others with back-up material to the Architect for approval.

2.2 GLASS

A. General: Glass shall comply with ASTM C - 1036 latest unless otherwise specified. Type and thickness as shown or specified.

B. Annealed Float Glass: Type I, Class 1, Quality q3, thickness as required by code or for strength with 1/4" minimum, unless otherwise noted or scheduled.

C. Laminated Glass: Clear, plain, heat strengthened or fully tempered laminated regular and safety glass with polyvinyl butyral [PVB] interlayer. Unless otherwise indicated or required by building and life safety codes, provide standard flat ASTM 1036 float glass for laminating. Unless otherwise shown or specified, provide 0.25 inch thick units. Where shown on drawings or specified, provide units with frosted interlayer in patterns, gradations, graphics or extent shown. See decorative glass below.

D. Tempered Glass: Glass for Tempering: Float, Type I, Class 1, Quality q4
1. Sizes and Cutting: Prior to tempering or heat strengthening, cut glass to required sizes as determined by accurate measurement of openings to be glazed, making allowance for required edge clearances. Cut and process edges in accordance with glass manufacturer's recommendations. Do not cut or treat edges in the field. Thickness: as required by code but 3/16"" minimum.
2. Standard: Provide glass complying with ASTM C - 1036 latest and meeting the requirements of ANSI Z97.1. Wherever possible locate tong marks along an edge which will be concealed in the glazing system. Do not exceed maximum warpage in any direction as listed in the latest printed literature of specified manufacturers.
3. Colors: As selected.
4. Basis of design products: See types below.

2.3 GLAZING SEALANTS AND COMPONENTS

A. General: Provide color of exposed sealant indicated or if not otherwise indicated, as selected by the Architect from manufacturer's standard colors, or black if no color is so selected. Comply with manufacturer's recommendations for selection of hardness, depending upon the location of each application, conditions at time of installation, and performance requirements as indicated. Select materials, and variations or modifications, carefully for compatibility with surfaces contacted in the installation. Sealants shall be coordinated with sealant requirements of other Sections of this specification to assure uniformity of color and appearance throughout the building.

A. Interior sealants: Subject to compliance with section 01 81 10:
1. Acrylic-Emulsion Glazing Sealant: Emulsion of acrylic, with or without latex rubber modification; compounded specifically for glazing; nonhardening, nonstaining and nonbleeding.

2.4 MISCELLANEOUS GLAZING MATERIALS

A. Materials include:
1. Setting Blocks: Neoprene blocks, 85 +/- 5 Shore A durometer hardness.
2. Face Shims: Neoprene blocks, 40 to 50 Shore A durometer hardness, self-adhesive on one face only. 2" long, spaced at 24" o.c. around perimeter, directly opposing each other on interior and exterior faces.
3. Edge Blocks: Neoprene blocks, 40 to 60 Shore A durometer hardness.
4. Elastomeric glazing spline and synthetic polymer tape.
5. Joint Cleaner, Primer and Sealer: Products recommended by the manufacturer.
6. Glazing compound: Provide clear, silicone glazing compounds at butt glazing joints and all glass corners of type recommended by manufacturer for application.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the provisions of Division 01 and in particular, Section 01 70 00.

3.2 PREPARATION

A. Clean glazing channels, stops and rabbets to receive glazing, materials of obstructions and deleterious substances which might impair the work. Remove protective coatings which might interfere with bond of sealants. Comply with manufacturer's instructions for final wiping of surfaces immediately before application of primer and glazing compounds or tapes.

B. Prime surfaces to receive glazing compounds in accordance with manufacturer's recommendations.

3.3 INSTALLATION

A. Standards: Unless otherwise shown or specified, comply with recommendations and requirements of the FGMA "Glazing Sealing Systems Manual" and "Glazing Manual". For the installation of tinted glass comply with glass manufacturer's recommendations.

B. Inspect each piece of glass immediately before installation. Do not install any pieces which are improperly sized or have damaged edges, scratches or abrasion or other evidence of damage. Remove labels from glass immediately after installation.

C. Locate setting blocks at sill one-quarter of the width in from each end of the glass, unless otherwise recommended by the glass manufacturer. Use blocks of proper size to support the glass in accordance with manufacturer's recommendations.

D. Provide face shims for all glass sizes larger than 50 united in., to separate glass from stops, except where continuous glazing gaskets or felts are provided. Locate face shims no farther than 24 in. apart and closer than 12 in. to a corner. Place face shims opposite one another. Make bite of spacer on glass a nominal dimension equal to or greater than that required by the manufacturer.

E. Provide edge blocks, located in glazing rabbet as recommended by the glass manufacturer, to insure against displacement of the glass and against metal to glass contact within the rebate and to ensure permanently adequate bite of the glass within the glazing system.

F. Set glass in a manner which produces greatest possible degree of uniformity in appearance.

G. Do not use 2 different glazing materials in the same joint system unless the manufacturer of each material has stated in writing that his material is fully compatible with the other material.

H. Use suitable protection to limit coverage of glazing materials to the surfaces intended for sealants.

I. Butt or lap ends of tapes in accordance with manufacturer's recommendations.

J. Tool exposed surfaces of glazing materials to provide a slight wash away from the glass. Install exposed tapes and gaskets with a slight protrusion above stops in the final compressed condition.

K. Glaze corners and glass to glass joints with clear tooled silicone.

3.4 PROTECTION

A. Protect glass lites from accidental breakage by installing crossed streamers in front of all glass immediately after completion of glazing work.

B. Do not apply markers or tape of any kind to glass surface.

3.5 CLEAN UP

A. Remove all labels, excess glazing compound and sealants from glass. Clean smudges and smears caused by the work of this Section from adjacent finishes and materials.

B. Repair or replace materials or finishes damaged by the work of this Section.

C. Remove from job site all glass crates and packaging. Remove all broken glass and properly dispose. Leave work areas neat and clean.

END OF SECTION

SECTION 08 91 10 METAL LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: The Drawings and general provisions of the Contract i and Division 1 apply to the work of this Section.

B. Section includes, without limitation providing:
1. Fixed metal wall louvers, horizontal and vertical types.
2. Accessories, subsills

1.2 SUBMITTALS

A. In accordance with Contract requirements, submit:
1. Shop Drawings: Provide large scale details and elevations for louvers specified herein.
2. Office Samples: Provide manufacturers standard finish color range, and if selected sample of custom color. Provide full size corner assembly when so requested.

B. Manufacturer's written installation instructions and descriptive literature.

C. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 PROTECTION

A. Protect work of this section and adjacent work from damage from work under this Section. Replace damaged work with new construction at no additional cost to the Owner.

1.4 GUARANTEE

A. Finish: Submit paint manufacturer's written guarantee for a period of 20 years on finish warranting prompt refinishing or replacement of painted work in the event that finish should

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
1. Construction Specialties, Inc.
2. Anemostat Door Products; www.anemostat.com/.
3. Approved equal.

2.2 ARCHITECTURAL LOUVERS

A. Provide types shown, if not, comply with requirements below.

B. Storm proof [aka storm resistant], fixed, horizonal louver. Architectural louvers:
1. Material: Extruded structural aluminum.
2. Thicknesses:
   a. Heads, sills, jambs, mullions, frames: 0.080 inch.
   b. Blades: 0.060 inch thick or more.
3. Heads, sills, jambs, mullions: One piece with integral caulking slot, retaining beads.
4. Subsills: Required.
5. Mullions: Provide sliding interlock.
6. Blades: One piece, drainable, with water stop at stop of blade.
7. Finish: As specified.
8. Depth: 5.00 inch.
9. Angle: Manufacturer recommendation for appliction.
10. Drainable: Yes.
11. Bird screen: Required.
12. Insect screen: If requested by Architect.

13. Stormproof: Yes.
14. Basis of design: As shown, if not, as follows:
    a. Horizontal: Construction Specialties, Inc. RS-5300 high performance louver
    b. Vertical: Construction Specialties, Inc. RSV-5700 high performance louver

2.3 FABRICATION

A. Blades: Extruded aluminum sections of 6063 - T5 alloy, minimum .075" thick.

B. Supports: All blades to be supported and lined up by means of heavy gauge extruded aluminum blade braces positively interlocked to each blade and secured to structural steel by type 302 stainless steel fastenings. Structural supports to be designed to carry wind pressures not less than code- mandated loads. At corners, blades shall be mitered and continuously heliarc welded.

C. Blank-Off Panels: Provide 1" thick aluminum faced painted insulated blank-off panels where ducts do not equal louver size.

D. Bird screen: Provide at all louver areas not having blank-off panels.

E. Subsills: Provide at all louvers unless indicated not to be provided.

2.4 FINISHES

A. Finishes (factory applied): Comply with Type 4 per Section 05 08 00 and provide Mica type with custom colors to match adjacent surfaces.

PART 3 - EXECUTION

3.1 INSTALLATION OF LOUVERS

A. Install per manufacturer's recommendations and written installation instructions to structural back-up. Where necessary apply bitumin between dissimilar metals.

B. Comply with manufacturer's instructions and recommendations for installation of the work.

C. Verify dimensions of supporting structure at the site by accurate field measurements so that the work will be accurately designed, fabricated and fitted to the structure.

D. Anchor louvers to the building substructure as indicated on architectural drawings.

E. Erection Tolerances:
1. Maximum variation from plane or location shown on the approved shop drawings: 1/8" per 12 feet of length, but not exceeding 1/2" in any total building length or portion thereof (non- cumulative).
2. Maximum offset from true alignment between two members abutting end to end, edge-to- edge in line or separated by less than 3": 1/16" (shop or field joints). This limiting condition shall prevail under both load and no load conditions.

F. Cut and trim component parts during erection only with the approval of the manufacturer or fabricator, and in accordance with his recommendations. Restore finish completely. Remove and replace members where cutting and trimming has impaired the strength or appearance of the assembly.

G. Do not erect warped, bowed, deformed or otherwise damaged or defaced members. Remove and replace any members damaged in the erection process as directed.

H. Set units level, plumb and true to line, with uniform joints.

I. Seal louver assemblies to abutting construction per Section 07 92 00.

3.2 CLEAN UP

A. Remove all scrap materials and clean up working areas daily as the work progresses. Remove all tools, equipment and excess materials at the completion of the work of this Section. Restore or replace work of other trades damaged or soiled by the work of this section.

END OF SECTION

SECTION 09 10 00 – NON-STRUCTRUAL LIGHT GAGE STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Interior steel framing for partitions.
2. Interior steel framing/suspension for ceilings.
3. Trimming, furring for interior board systems.
4. Miscellaneous framing.

C. Related Work Specified Elsewhere
1. Section 06 10 60– Wood blocking wood treatments
2. Section 09 29 00 – Gypsum Board
3. Section 09 10 50 – Metal blocking
4. Divison 7 – Doors & frames
5. Divison 9 – Acoustical ceilings: panel suspension assemblies.
6. Section 09 81 10 – Acoustic insulation & accessories

1.2 SUBMITTALS

A. In accordance with the provisions of Division 01, and this article, submit the following:
1. Manufacturer's Printed Literature:
2. Technical specifications, details and installation instructions for specified products.

B. Shop Drawings: Provide shop drawings for all structural elements of the work. Show plans, elevations, sections, and details at a scale sufficient to show composite fabrications and installation. Show all points of attachment, terminations, and relationships with adjacent construction. Coordinate as required with other trades and manufacturers. Shop drawings shall include:
1. Interior partitions, walls and ceilings:
2. deflection head at full height partitions
3. other special conditions

C. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE:

A. Framing for fire-resistance-rated gypsum board assemblies shown or specified shall be identical to the referenced "Test Designs" as published in the Gypsum Association "Fire Resistance Design Manual," the UL "Fire Resistance Directory" or listings of other testing agencies acceptable to authorities having jurisdiction. See these publications for fully detailed construction requirements.

B. Reference Standards: The following standards shall govern the work of this Section:
1. Building Code in force at the project site.
2. Installation of steel framing: ASTM C-754
3. Terminology: Gypsum Association GA-505.
4. United States Gypsum *The Gypsum Construction Handbook*, current edition.

C. Tolerances for Drywall Work:
1. Do not exceed a variation of 3/16" in 8'-0", and 1/8" in 4'-0", from plumb, level and flat (all directions).
2. Level main runners to a tolerance of 1/4" in 12'-0", measured both lengthwise on each runner and transversely between parallel runners.

D. Performance Provide the services of a professional engineer legally qualified to practice in the Project's jurisdiction and experienced in designing comparable assemblies. Design and certify that the work of this section meets or exceeds the performance specified herein, including:
1. Limit deflection to L/240 for non-rigid finishes and L/360 for rigid finishes applied over drywall.
2. Certify that manufacturer's minimum gages are met for indicated heights and applications.
3. In the absence of other requirments design vertical studs for 7.5 pounds per square foot.

E. Fire-Test Response Characteristics: Where required for fire ratings, provide assemblies identical to indicated assemblies tested by ASTM E119.
1. Partition head conditions: Comply with design designations from UL's Fire Resistive Diretory.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery and Handling: Deliver materials to the project site with manufacturer's labels intact and legible. Handle materials with care to prevent damage. Deliver fire-rated materials bearing testing agency label and required fire classification numbers.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Framing & Support: Provide manufacturers from one of the following if they meet or exceed these specifications:
1. ClarkWestern
2. Clarke Dietrich Building Systems
3. USG.
4. EB Metals, Inc.

2.2 PARTITION AND WALL FRAMING MATERIALS

A. Metal Studs: ASTM C 645; sizes as shown. Studs shall be of the type and gauge required to meet the design and loading criteria or standards in manufacuturer's published tables and literature. Provide manufacturer's standard protective coating. Provide galvanized steel studs with not less than ASTM A653 G60 hot dipped galvanized zinc coating.
1. At interior partitions and column enclosures (ceiling height and full height) use 3-5/8" studs unless otherwise indicated. Use gauges and spacing per manufacturer's minimums.
2. Provide minimum 20 gage steel studs at walls to receive ceramic tile
3. Provide minimum 20 gage steel studs at door jambs and fixed glass frames, at open partition ends, and where partition is to receive wall mounted shelves, heavy fixtures and the like.
4. Studs at perimeter exterior walls subject to exterior windloads: Provided by Section 05 40 00.

B. Runner Tracks: ASTM C645, type recommended by stud manufacturer for friction fit to studs. Provide zinc coating to match studs.

C. Rigid Furring: ASTM C 645; hat-shaped , 0.0247 inch where secured to solid substrate and 20 gauge minimum where spanning over 48 inches. Provide zinc coating to match studs

D. Resilient Furring and Hangers:
1. Resilient Furring: Comply with Section 09 81 10 – Acoustic insulation & accessories; if none, use ClarkDietrich RC-1 Pro Deluxe series x 25 gage.
2. Resilient Hangers: Comply with Section 09 81 10 – Acoustic insulation & accessories

E. Z-Furring Members: Manufacturer's standard screw-type galvanized steel, zee-shaped furring members; ASTM A-525, G60, .0276" min. thickness of base metal; of depth indicated; designed for mechanical attachment of insulation boards or blankets to monolithic concrete and masonry walls.

F. Flat Steel Strap & Backing Plates: Sheet steel for blocking and bracing in length and width as required for application with a minimum thickness of 0.0179 inches and in no case less than recommended by USG for application. Provide zinc coating to match studs.

G. Fasteners for Furring Members: Type and size recommended by furring manufacturer for the substrate and application indicated.

H. Miscellaneous Accessories: Provide all other accessories as required for a complete job including, but not limited to:
1. Metal angles: .0276" thick, galvanized steel.
2. Cold-rolled channels: .0635" thick, galvanized or black asphaltum painted.
3. Furring channel clips: galvanized steel wire manufactured by furring channel manufacturer.
4. Tie wire: Galvanized soft annealed wire. Gauge per manufacturer's recommendations.

I. Slip-Type Head Joints: As shown, if not, where required to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; provide:
1. Deflection Track: Steel sheet top runner manufactured to specifically for anticipated movements in thickness not less than indicated for studs and in width to accommodate depth of studs.
2. Products: Subject to compliance with requirements, provide one of the following:
a. Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
b. Steel Network Inc. (The); VertiClip SLD or VertiTrack VTD Series.
c. Superior Metal Trim; Superior Flex Track System (SFT).
d. Telling Industries; Vertical Slip Track or Vertical Slip Track II.
e. Approved equal.

2.2 CEILING SUPPORT SYSTEM

A. General: Manufacturer's standard zinc-coated or painted steel system of main runners, cross tees, furring channels, wall angles, hangers and accessories designed for concealed support of gypsum drywall ceilings; of proper type for use intended.

B. Size and Spacing of Ceiling Support Components: Contractor design ceiling support ystem to comply with ASTM C 754, unless otherwise indicated.

C. Components:
1. Main Runners: Steel channels with rust inhibitive finish, hot or cold-rolled.
2. Hanger Wire: ASTM A 641, soft, Class 1 galvanized.
3. Hanger Anchorage Devices: Screws, clips, bolts, cast-in-place concrete inserts or other devices applicable to the indicated method of structural anchorage for ceiling hangers and whose suitability for use intended has been proven through standard construction practices or by certified test data. Size devices for 3x calculated load supported, except size direct pull-out concrete inserts for 5x calculated loads.
4. Rigid Furring Members: ASTM C 645; 020 gauge minimum. thickness of base metal, hat-shaped.
5. Resilient Furring: Same as above.
6. Furring Anchorages: 16-gage galvanized wire ties, manufacturer's standard wire-type clips, bolts, nails or screws as recommended by furring manufacturer and complying with C 754.

D. Proprietary Framing System:
1. Framing system for gypsum board panels consisting of cold-rolled steel members conforming to ASTM C635, with exposed surfaces finished in manufacturer’s standard enamel paint finish.
2. Fire rating: Hourly rating in accordance with assembly indicated.
3. Components: Main tees, furring cross channels, furring cross tees, and cross tees.
4. Accessories:
a. U-shaped channel molding.
b. Galvanized carbon steel (12 ga.) hanger wire.
5. Acceptable product: Equivalent to Drywall Suspension System by USG.

PART 3 - EXECUTION

3.1 GENERAL

A. Unless otherwise indicated, install products specified in this Section or elsewhere in accordance with the respective manufacturer's referenced instructions and standards.

3.2 INSPECTION AND ACCEPTANCE OF SURFACES

A. Examine substrates and other work to be contiguous with framing systems. Do not proceed with the work until unsatisfactory conditions, alignment, and spacing have been corrected. Commencement of work constitutes acceptance of pre-existing conditions.

3.3 INSTALLATION OF STEEL FRAMING AT PARTITIONS

A. Manufacturer's Instructions: Unless otherwise shown or specified, install metal framing and accessories in accordance with manufacturer's printed instructions and standards.

B. Deflection Head: Where partitions abut structural deck or horizontal structural elements, provide slip connection as shown. If not shown, then comply with detailing recommended by the manufacturer.

C. Do not bridge building expansion joints with support system, frame on both sides of joints. Make wallboard discontinuous. Back and seal joints.

D. Height of Partitions: Carry all drywall partitions full height to floor or roof above, unless otherwise indicated on the drawings.

E. Floor and Head Runner Tracks: Fasten stud tracks as follows unless manufacturer's recommendations are more stringent.
1. Interior Partitions: stagger fasteners at 24" o.c.

F. Studs (except at deflection head): Use full length studs between runner tracks. Friction fit studs to runner tracks by positioning and rotating into place. Screw to floor and head tracks.
1. Spacing: 16 inches o.c. at interior partitions, unless otherwise noted.

G. Studs (at deflection head): Cut studs 1/2" short of full height. Provide screw fastening at floor track only; friction fit only at head track. Provide bridging between tops of studs to maintain proper vertical alignment and spacing.

H. Fasteners: 5/8" low profile, self-tapping screws through both flanges.

I. Additional studs: Provide additional studs at partition intersections and corners, terminations of partitions, both sides of control joints and wall mounted door stops, per manufacturer's recommendations.

J. Install supplementary framing, blocking and bracing at terminations in the work and as necessary for the rigid support of wall-mounted fixtures, equipment and services, heavy trim, grab bars, toilet accessories, furnishings, and similar work. Coordinate with other trades for locations and methods of anchorage.

K. Rough Framing at Window Openings: Provide additional doubled-up full-length studs adjacent to jambs, and horizontal head and sills. Cut horizontal tracks to length, split flanges and bend webs at ends for flange overlap and screw to jamb studs. Install cut-to-length, intermediate studs above and below openings, at same spacing as full-length studs.

L. Framing at Doors: Provide metal or fire retardent wood blocking at head and jambs; secure blocking rigidly in place.

M. Furring: Space furring members 16 inches o.c. unless otherwise indicated. At concrete and masonry walls, install furring vertically to eliminate end joints unless otherwise approved by Architect.

3.4 INSTALLATION OF CEILING SUPPORT SYSTEM

A. Secure hangers to structure by connecting directly or by connecting to inserts, clips or other anchorage devices or fasteners as indicated.

B. Space main runners 4'-0" o.c. and space hangers 4'-0" o.c. max. along runners, except as otherwise shown.

C. Wire-tie or clip furring members to main runners and to other structural supports at 16" o.c. unless otherwise shown.

D. Ceiling Perimeter Member: Attach perimeter wall track or angle wherever support system meets vertical surfaces. Mechanically join support members to each other and butt-cut to fit into wall tracks.

3.5 CLEAN UP

A. Keep work areas clean and free of debris by daily sweeping.

B. At the completion of work in any areas or on any floor, completely clean work area of scrap studs and leave area broom clean.

C. Restore or replace work of other trades damaged or soiled by the work of this Section.

END OF SECTION

SECTION 09 10 50 - METAL BLOCKING

PART 1 GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section Includes, without limitation providing:
1. Concealed metal blocking.
2. At contractor's option, use specified metal blocking in place of wood at building interiors.

B. Related Work includes, without limitation:
1. Section 06 10 60 - Wood blocking.

C. Extent: As required, but **do <u>not</u> for use as firestopping**.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Performance: Fire, structural, and seismic performance meeting requirements of building code and local authorities.

PART 2 PRODUCTS

2.1 MATERIALS

A. Steel Studs, Channels & Plates:
1. Material Standard: ASTM C645.
2. Stud Thickness: 25, 22, or 20 gauge (.0329 inch), as required by application, galvanized.
3. Stud Depth, Minimum: 2.5 inches.
4. Cold-rolled Channel: 16 gauge, minimum black corrosion resistant coating.
5. Flat Plates: 16 gage minimum, galvanized; spanning at least 3 supports.
6. Auxiliary Framing Components: non-corrosive fasteners.

PART 3 EXECUTION

3.1 INSTALLATION -GENERAL

A. Steel Blocking: Connect to framing in compliance with ASTM C 754. Include blocking for items such as railings, grab bars, casework, toilet accessories, window treatment and similar items. Comply with the following:
1. Determine loads and select blocking to support loads and meet safety factor of 3. When in doubt field test assemblies with actual loads.
2. Conceal blocking completely.
3. Do not permit telegraphing or visual bleed-through of blocking through final finish surfaces.
4. Do not interfere with or obstruct other work.
5. Use manufacturer recommended fasteners where they exceed strength of specified fasteners.
6. Alternative methods have equal structural capacity may be used other than specified. Gages and weights

specified are minimums and shall not be reduced.

3.2 MINIMUM PERFORMANCE & INSTALLATION REQUIREMENTS

A. Type 1 - Heavy Loads: Without limitation, grab bars, handrails, wall supported casework and shelving, other heavy loads. Comply with the following:
1. Withdrawal resistance: 200 pounds.
2. Shear resistance: 250 pounds.
3. Support: Maximum 8 inch long segments of specified steel channel run horizontally and attached to each side open throat of metal wall studs; overlap channel across entire face of stud flange.
4. Fastener: 0.25 inch minimum diameter attached through center of channel.

B. Type 2 - Moderate Heavy Loads. Comply with the following:
1. Withdrawal resistance: 155 pounds.
2. Shear resistance: 175 pounds.
3. Support: Toggle bolt through 0.50 inch minimum gypsum board and attached to center of 25 gage minimum metal stud.
4. Fastener: 0.25 inch minimum diameter toggle bolt.

C. Type 3 - Moderate Loads. Comply with the following:
1. Withdrawal resistance: 85 pounds.
2. Shear resistance: 135 pounds.
3. Support: Toggle bolt through 0.50 inch minimum gypsum board and attached to center of 20 gage minimum metal stud.
4. Fastener: Type S-12 bugle head \ screw.

D. Type 4 - Light Loads. Comply with the following:
1. Withdrawal resistance: 85 pounds.
2. Shear resistance: 135 pounds.
3. Support: Toggle bolt through 0.50 inch minimum gypsum board and attached to center of 25 gage minimum metal stud.
4. Fastener: Type S-12 bugle head \ screw.

E. Type 5 - Very Light Loads. Comply with the following:
1. Withdrawal resistance: 40 pounds.
2. Shear resistance: 60 pounds.
3. Support: Toggle bolt through 0.50 inch minimum gypsum board only.
4. Fastener: 0.25 inch minimum diameter toggle bolt.

END OF SECTION

SECTION 09 28 10 - INTERIOR CEMENT BACKER BOARD

PART 1 GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing: Interior cement board.

C. Extent: As substrate for tiled walls, in every location.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Tolerances: Not more than 1/16-inch difference in true plane at joints between adjacent boards before finishing. After finishing, joints shall be not be visible. Not more than 1/8 inch in 10 feet deviation from true plane, plumb, level and proper relation to adjacent surfaces in finished work.

C. Fire Resistance for Fire-Rated Assemblies: ASTM E 119.

PART 2 PRODUCTS

2.1 MATERIALS

A. Cement backer board meeting or exceeding the following:
1. Material: Aggregated Portland cement board with woven glass fiber mesh facing.
2. Standard: Complying with ANSI A118.9.
3. Thickness: As shown, if not: 5/8 inch.
4. Fire rating assemblies: Comply with requirements of fire tests. Provide mineral rock wool where required for compliance as part of work.
5. Widths & edges: Manufacturer’s standard.
6. Product: “Durock” by USG, CertainTeed, Georgia Pacific or approved equal.
7. Fasteners: Only manufacturer recommended cement backer board type such as Durock screws. Do not use conventional drywall screws or fasteners.

B. Steel Framing for Walls and Partitions: Ensure compliance with the following:
1. Stud Thickness: 20 gauge (.0329 inch), minimum

C. Furring Channel Thickness: 20 gauge (.0329 inch).

2.2 JOINT FINISHING

A. Where joint finishing is required under this section, comply with requirements listed below.

B. Joint tape: Alkali-resistant glass-fiber tape.

C. Joint compound: Use only products as listed below
   1. Do not use drywall joint compound directly over cement board unless it has been sealed using a product recommended by the manufacturer and accepted by the Architect.
   2. Dry-set mortar mixed with acrylic latex additive meeting ANSI A118.1;
   3. Latex portland cement mortar meeting ANSI A118.4

PART 3 EXECUTION

3.1 INSTALLATION

A. Install cementitious cement fiber tile backer board using fiberglass tape and hot dipped galvanized or cadmium plated fasteners. Follow manufacturers installation recommendations and requirements of ANSI A108.11. Install tile backer board where indicated and at all bath tub walls and ceilings.

B. Provide fire-rated systems where indicated and where required by authorities having jurisdiction. Do not use cement board to achieve fire ratings, unless UL test assembly numbers are provided to Architect for review.

C. Install boards vertically. Do not allow butt-to-butt joints and joints that do not fall over framing members.

D. Install trim in strict compliance with manufacturer's instructions and recommendations.

E. Repair surface defects. Leave ready for finish painting or wall treatment or tile application.

END OF SECTION

SECTION 09 29 00 - GYPSUM BOARD

PART 1 GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Gypsum board components and assemblies.

1.1 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.2 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Tolerances: Not more than 1/16-inch difference in true plane at joints between adjacent boards before finishing. After finishing, joints shall be not be visible. Not more than 1/8 inch in 10 feet deviation from true plane, plumb, level and proper relation to adjacent surfaces in finished work.

C. Fire Resistance for Fire-Rated Assemblies: ASTM E 119.

D. Mock-Ups: Provide mock-up as required to demonstrate quality of workmanship and level of finish.

E. Performance: Fire, structural, and seismic performance meeting requirements of building code and local authorities.

1.3 JOB CONDITIONS

A. Environmental Conditions:
1. Temperature and Humidity Conditions: Do not install wallboard or joint treatment compounds unless conditions in installation areas comply with the minimum temperature, humidity and ventilation requirements recommended by the manufacturer.
2. Temperature: During cold weather, in areas receiving installation, maintain temperature range between 50`F to 70`F for 24 hours before installation, during installation, and for 24 hours after gypsum wallboard or plaster is applied and joint treatment has cured fully.
3. Ventilation:
   a. Provide ventilation during and following adhesives and joint treatment applications.
   b. Use temporary air circulators in enclosed areas lacking natural ventilation.
   c. Under slow drying conditions, allow additional drying time between coats of joint treatment.
   d. Protect installed materials from drafts during hot dry weather.

B. Protection: Protect adjacent surfaces against damage and stains.

C. Coordination with Other Trades:
1. Coordinate drywall work with other trades. Frame recesses for accessories and equipment provide under other Sections.
2. Examine hollow metal details and coordinate framing and board application with that Section.

PART 2 PRODUCTS

2.1 GYPSUM DRYWALL BOARD - CONVENTIONAL

A. General: Where shown or scheduled, provide gypsum wall board of each type as specified. Provide in longest lengths available to minimize end-to-end joints.
1. Provide thickness as shown or as required by laboratory test designs to achieve the fire and acoustical ratings shown.
2. Where indicated UL or FM or NFPA fire rated assemblies require the use of so-called “Type C” firecode color, use that board in place of generic Type X. Note: Most manufacturers have replaced their type C assemblies with Type X based upon UL ULIX tests using products such as USG Sheetrock EcoSmart MoldTough Firecode X.

B. Lightweight gypsum wallboard: Subject to review and written approval, so-called lightweight sustainable products with matching UL, mold, impact resistance, and ASTM performance ratings may be used, such as USG EcoSmart panel series.

C. Gypsum Wallboard / Conventional:
1. Use: Interior locations, base layers only.
2. Type: Regular or Fire Resistant (Type X), as shown.
3. Backing: Paper-backed.
4. Thickness: 5/8" unless otherwise shown.
5. Edges: Tapered and rounded edge (Type SW).
6. ASTM Specification: C-1396

D. Gypsum Wallboard / Impact Resistant:
1. Use: As shown, if not, at all at Interior locations, exposed layers only.
2. Type: Fire Resistant (Type X).
3. Abuse rating: Per ASTM C1629, level shown if not, level 1 for surface indentation, Level 2 for abrasion.
4. Face: Paper face with stronger back paper and higher density core than conventional board.
5. Thickness: 5/8" or as shown.
6. Edges: Tapered and rounded edge (Type SW).
7. ASTM Specification: C-1396
8. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
9. Finishing: Conventional methods per manufacturer recommendations.
10. Acceptable product:
    a. USG Sheetrock ® Mold Tough VHI Firecode X Panel UL Type AR

E. Gypsum Wallboard / Abuse Resistant:
1. Use: As shown, if not, at all at Interior locations, exposed layers only.
2. Type: Regular or Fire Resistant (Type X). , as shown.
3. Abuse rating: Per ASTM C1629, level shown if not, level 1.
4. Face: No paper face.
5. Thickness: 5/8" or as shown.
6. Edges: Tapered and rounded edge (Type SW).
7. ASTM Specification: C-1396
8. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
9. Finishing: Full skim coat per manufacturer recommendations.
10. Acceptable product where paperless board are shown: USG Sheetrock Glas-Mat Mold Tough VHI [very high impact] AR Firecode X.

F. Moisture & Mold Resistant [Formerly Water-Resistant gypsum panel]:
1. Use: Painted wallboard at kitchens, laundries, toilet rooms, showers, janitors closets, and all other moist but not wet areas. Do not use behind tile nor at tub surrounds.
2. ASTM C1396 (Section 5), regular type except where Type X fire-resistant type is indicated or required to meet UL assembly types.
3. Edges: Tapered.

4. Thickness: As shown, if not shown 5/8 inch.
5. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
6. Acceptable products: USG Sheetrock® brand Mold Tough™ Firecode (Type X).
7. Acceptable product where paperless board are shown or required:
   a. Sheetrock MoldTough (USG)
   b. Sheetrock MoldTough VHI (USG)
   c. DensAmor Plus Impact resistant panel by Georgia Pacific
   d. Finishing: Full skim coat per manufacturer recommendations.

G. Exterior Soffit Board:
1. Manufacturer's special weather and sag-resistant gypsum board manufactured specifically for use in exterior soffit applications with indirect exposure to weather; complying with ASTM C1396 (Section 8).
2. Edges: Eased and tapered.
3. Thickness: 5/8 inch, except as otherwise indicated.
4. Acceptable product: Equivalent to USG Sheetrock® MoldTough Firecode X exterior rated gypsum ceiling board.

2.2 FASTENERS FOR GYPSUM BOARD:

A. Screws: Comply with ASTM C1002 and ASTM C954 Type ”S” at steel, Type “W” at wood and be rustproof, of size, thread, head, and points recommended by manufacturer for applications shown. Generally, provide screws with maximum clamping strength and vibration resistance, 3/8" longer than the assembly being fastened.

B. Power driven fasteners for attachment to 20 gage runners at 3000 psi concrete shall be 5/32” diameter, length determined by installer.

C. At exterior and wet locations and at tile backer board use hot dipped galvanized, stainless stell or cadmium plated fasteners.

2.3 METAL TRIM ACCESSORIES

A. General: Provide trim accessories of the sizes required for the drywall application shown and specified, fabricated from galvanized steel, and of the following types:
1. At external corners: Provide 1-1/4" x 1-1/4" galvanized metal corner bead with smooth rigid nose and perforated and knurled metal flanges.
2. Expansion Control Joints: U.S. Gypsum "093" or approved equal located as shown or at 30' (maximum) intervals in long straight runs. Where locations are not shown on Drawings, obtain Architect's approval of proposed locations.
3. Edge moldings: Provide perforated and embossed "L" or "J" type casing molding at exposed panel edges and where GWB butts other materials, similar to U.S. Gypsum 200 or 800 series. Moulding equal to U.S. Gypsum Series 400 is not acceptable.
4. Multiflex tape beads.

2.4 JOINT TREATMENT AND FINISH MATERIALS

A. General: Provide materials recommended by the manufacturer for the use intended, complying with ASTM C-475, except as noted below.
1. Joint Tape: Fibered paper reinforcing tape.
2. Joint Compounds:
   a. At moist interior areas provide chemical-hardening type for bedding and filling and ready-mixed all purpose vinyl-type or vinyl-type powder for topping. U.S.G. Durabond, or equal topped with a sandable all purpose final coat is acceptable.
   b. At interior applications provide standard ready mix vinyl-based taping plus topping compound or vinyl-based powder taping plus topping compound.

c. At moisture resistant gypsum backing board, for joints, cut edges and fastener heads provide special moisture - resistant compound equal to U.S. Gypsum w/r compound (1 coat under tiles, 3 coats other areas).

B. At exterior conditions use products water resistant exterior grade products.

C. Sustainability: Maximum VOC levels for joint compound: < 50 grams per liter, less water.

PART 3 EXECUTION

3.1 GENERAL

A. Comply with the provisions of Section 01 70 00 - especially requirements related to:
1. Inspection and examination.
2. Tolerances and measurement.
3. Approvals, inspections and filed quality control.

B. Critical work under other sections: Provide under their respective sections and ensure that:
1. Framing is installed with tolerances necessary to produce results required.
2. Ensure metal stud framing for high impact gypsum board is required minimum gage or heavier. In the absence of other indications for stud gage for impact type partitions, use 20 gage studs.
3. Blocking for items such as railings, grab bars, casework, toilet accessories, window treatment and similar items are in place, secure and solid.
4. Vapor barriers where required or shown are in place and in good condition.
5. Acoustical sealant at both faces at top and bottom runner tracks, wall perimeters, openings, expansion and control joints are provided for and installed properly.
6. Required thermal or acoustical insulation is in place.

3.1 INSTALLATION

A. Steel Framing: Install steel framing in compliance with ASTM C 754. Install with tolerances necessary to produce substrate for gypsum board assemblies with tolerances specified. Include blocking for items such as railings, grab bars, casework, toilet accessories, window treatment and similar items.

B. Wood Framing: Install wood framing in compliance with Division 06 00 00 - Rough Carpentry. Install with tolerances necessary to produce substrate for gypsum board assemblies with tolerances specified. Include blocking for items such as railings, grab bars, casework, toilet accessories, window treatment and similar items.

C. Tape and Joint Compound: Install gypsum board for tape and 3-coat joint compound finish in compliance with ASTM C 840 and GA 216, Level 4 finish. Install gypsum board assemblies true, plumb, level and in proper relation to adjacent surfaces. Provide special level finishes as follows:
1. Concealed from view not fire rated: Level 1 or better.
2. Concealed from view fire rated: Level 2 or better but in compliance with fire ratings.

D. Veneer Plaster: Install gypsum board for veneer plaster finish in compliance with ASTM C 844. Install gypsum board assemblies true, plumb, level and in proper relation to adjacent surfaces.

E. Provide continuous vapor retarder at exterior walls.

F. Provide fire-rated systems where indicated and where required by authorities having jurisdiction.

G. Install boards vertically. Do not allow butt-to-butt joints and joints that do not fall over framing members.

H. Install trim in strict compliance with manufacturer's instructions and recommendations.

I. Repair surface defects. Leave ready for finish painting or wall treatment.

END OF SECTION

SECTION 09 30 05 – INTERIOR CERAMIC & PORCELAIN TILING

PART 1 GENERAL

1.1 SUMMARY

A. Related documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section Includes, without limitation providing: tiling.
1. Ceramic tile.
2. Porcelain tile.
3. Stone thresholds.
4. Crack isolation & waterproof membranes membrane.
5. Specialty tile products.
6. Grout and setting materials.
7. Metal edge strips.

C. Extent:
1. Where shown.

D. Related Work includes, without limitation:
1. Division 09 00 00 – Other tiling work.
2. Section 09 28 10 - Interior cement backer board.
3. Section 09 30 50 Prefabricated Shower Bases For Tiled Walls
4. Section 10 28 10 - Toilet Accessories

1.2 SUBMITTALS

A. Comply with Division 01 and the following:
1. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.
2. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.
a. Include manufacturer’s full range of color and finish options if additional selection is required.

B. Extra materials: Not less than 2 percent of installed materials.

C. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions. Meet or exceed the following:
1. Tile: ANSI A 137.1.
2. Tile Setting Materials: ANSI A 118 series standard specifications.
3. Tile Installation: ANSI 108 series standard specifications and Tile Council of America, Handbook for Ceramic Tile Installation.

B. Mock-Ups: Provide mock-up as required to demonstrate quality of workmanship.

C. Slip resistance: Comply with Dynamic Coefficient of Friction [DCOF] AcuTest rating of 0.42 or better.

D. Tolerances for Tile Work: Install setting beds and apply tile so that final exposed tile surfaces are smooth and true to within the following tolerances:
Floors: 1/8 inch in 10 feet max.
Walls: 1/8 inch in 8 feet max.

E. Provide flood testing where waterproofing membranes are required for installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Tile: Refer to Finish Legend and Finish Schedule for required tile types.

B. Subject to compliance with requirements, and indications on Finish Legends, provide products from manufacturers below:

C. Tile material manufacturers:
1. American Marazzi Tile, Inc.
2. American Olean Tile Co.;
3. DalTile Corporation; Endicott Clay Products Co.;
4. Summitville Tiles,
5. United States Ceramic Tile Co.
6. Approved equal.

D. Setting Materials manufacturers:
1. American Olean Tile Co.; Bostik, Inc.; Custom Building Products.
2. LATICRETE International, Inc.
3. MAPEI Corp.
4. ProSpec (formerly Bonsal branded products).
5. Schluter System LP;
6. Super-Tek Products, Inc.;
7. TEC Specialty Construction Brands, Inc.; or approved equal.

2.2 APPLICATIONS / TILE TYPES

A. Provide applications shown, including:
1. Interior wall tile over concrete and concrete masonry units.
2. Interior wall tile over tile backer board at wet areas.
3. Interior floor tile over concrete slab.

B. Tile types required, as shown or scheduled including:
1. Glazed ceramic tile.
2. Porcelain tile.

C. Setting Materials:
1. Mortar setting bed: Provide where required, not at showers. Latex additive
2. Thin-set mortar: Dry-set Portland cement mortar.
3. Grout: Latex-Portland cement grout. (Silicone rubber elastomeric grout for pregrouted sheets.)
4. Crack suppression membrane under tile ANSI A 118.10.
5. Elastomeric sealants, low VOC type.

2.3 PORCELAIN FLOOR & WALL TILE

A. Tile type: As indicated on Finish Legend but complying with the following:
1. Size: As shown.
2. Edge: As selected, if not slight cushion edge,
3. Performance: Slip and stain resistant floor tile.
4. Standard: Comply with ANSI A137.1 and provide tiles of:
   a. Dense, fine-grained, sharply formed face.
   b. Unless otherwise selected, provide dust-pressed composition.
5. TCNA rating: Certified as porcelain tile.
6. ADA: Comply with applicable standards, especially slip-resistance.
7. Porcelain Enamel Institute [PEI] Resistance to wear: Unless otherwise selected, Group; IV or V, extra heavy, high traffic, commercial, interior/exterior use.
8. Texture: As shown or scheduled, if not, lightly textured surface.
9. Trim & shapes: Provide matching trim special conditions.
10. Wet coefficient of friction: 0.6 or better.
11. ANSI rating: Impervious.

12. Absorption range: of 0.5 per cent or less.
13. Body: Unless otherwise selected, provide full body, homogeneous color and texture through full thickness of tile.
14. Grout joint: Width recommended by manufacturer is 1/8 inch.

2.4 GLAZED CERAMIC WALL TILE

A. Provide tile complying with the following:
1. Tile type: plain face all-purpose edge crystalline-glazed wall tile
2. Size: As shown.
3. Standard: Comply with ANSI A137.1.
4. Moisture Absorption: < 20 per cent.
5. Setting grid: Optional; back-mounted.
6. Grout spacers: Required wherever setting grids are not used.
7. Trim: Provide matching trim and shapes for special conditions.
8. Base: Required; where type not indicated, use wall tile material.
9. Manufacturer: As scheduled.
10. Series: As scheduled.
11. Colors: As selected by Architect from full standard range plus not less than 20% feature tile.
12. Usage: Where shown.

B. See drawings and Owner standards for floor patterns, special conditions at base corners. Patterns shall include not less than 3 colors in custom layout designed by architect.

2.5 SPECIALTY TILE COMPONENTS

A. Metal Edge strips: Units by Schluter or approved equal:
1. Suitable for application to ensure smooth transitions, including:
a. Tile to tile.
b. Tile to carpet.
c. Tile to resilient flooring

2.6 SEALANT

A. For all tile sealing work provide white sanitary silicone tile sealant complying with Fed. Spec. TT-S-001543 equal to Tremco "Proglaze", or GE 1702.

2.7 CRACK SUPPRESSANT / WATERPROOFING MEMBRANE

A. Usage: Where waterproofing or crack suppressant required under tile assemblies not in showers or at tubs.

B. Provide products meeting or exceeding the following:
1. Material: Self curing liquid rubber polymer.
2. Reinforcing fabric: Yes.
3. Application: Capable being installed horizontally, vertically and on ceilings.
4. Application: Brush or roller.
5. GreenGuard certified: Yes.
6. Clean up: With water while fresh.
7. Color: Black.
8. Physical Performance standard; ANSI A118.10, meeting criteria below.
9. Fugus resistance: Pass.
10. Seam Strength: > 95 lbs/ inch width.
11. Breaking strength: 2400 psi.
12. Dimensional stability: No change.
13. Shear: 280 psi.
14. Performance: Extra heavy duty rated.
15. Crack Suppressant: Yes, up to 1/8 inch per ANSI 118.12.
16. Thickness: 0.02 inch when cured.
17. Hydrostatic resistance: 120 psi.
18. Maximum acceptable deflection: L/360
19. Product: Laticrete 9325 Waterproof Membrane by Laticrete International of Bethany CT or approved equal.

20. Submit this product and comparable Schulter products and make recommendations to Owner and Architect based upon superior performance and tile installer recommendations. Final system selection by Owner and Architect.

C. Waterproofing accessories for recesses: Pre-formed, seamless product designed for application; equal to Barwalt Duk Liner; http://www.barwalt.com/products/accessories/duk-liners/; or approved equal.

2.8 MARBLE THRESHOLD

A. Marble for saddles shall be "Vermont Imperial Danby" produced by Vermont Marble Co., or "Madre Cream" by Alabama Marble Co. division of Georgia Marble Co., or equal conforming to or within range of approved samples.

B. Marble saddles shall be 1/2" thick x width of door, unless otherwise indicated, sand rubbed finish, and beveled front and back, unless otherwise detailed.

C. Verify dimensions and profiles of marble saddles. Do not fabricate until shop drawings have been approved by Architect.

D. Provide custom shapes and cuts to allow thresholds to accommodate changes in floor levels where new tile is installed over existing tile and comply with Architectural Access Code.

2.9 SLOPED BED / UNDERLAYMENT & LEVELING COMPOUNDS

A. Cementitious leveling materials: Provide materials suitable for application depending upon conditions such as existing unacceptable slabs, or wood flooring or cut-back mastics. Appropriate products include: “Masco Latex Cement” latex admix”, “Mascrete Latex Flooring Cement”, “Silflo 200 Self-Leveler” mixed with C-21 Acrylic, all by Silpro Masonry Systems of Ayer MA or comparable products by Ardex Inc. or approved equals. Provide products which can be feathered to zero and either trowel applied or self-leveling.

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with Tile Council of America and ANSI Standard Specifications for Installation for substrate and installation required. Comply with manufacturer's instructions and recommendations.

B. Install crack suppressant membrane in accordance with manufacturer's instructions and recommendations.

C. Lay tile in grid pattern with alignment grids. Layout tile to provide uniform joint widths and to minimize cutting; do not use less than 1/2 tile units.

D. Provide sealant joints where recommended by TCNA and approved by Architect.

E. Grout and cure, clean and protect.

3.2 METHODS FOR INSTALLATION OF INTERIOR FLOOR TILE

A. Dry-Set Latex-Portland cement mortar: Comply with TCNA guide spec and the following:
1. Method: F125.
   a. Substrate: Concrete or cured mortar bed.
   b. Crack isolation membrane: Latex-Portland cement, ANSI 118.2
   c. Mortar bond coat: Latex-Portland cement, ANSI 118.4.
   d. Grout: Polymer modified, ANSI A118.7.
   e. Grout joints: Width indicated, if not, 0.0625 [1/16] inch, using rectified tiles of equal faces and dimensions.
5. Preparation: Slope subfloors 0.25 inch to drain.
6. Installation of tile: ANSI A108.5.
7. Movement joints: Provide per EJ171.
8. Usage: Where shown, and, tiled floors not subject to direct spray water.

B. Thin-set with Waterproof membrane: Comply with TCNA guide spec and the following:
1. Method: F122.
   a. Substrate: Concrete or cured mortar bed.
   b. Mortar: Latex-Portland cement, ANSI 118.4.

c. Grout: Polymer modified, ANSI A118.7.
d. Grout joints: Width indicated, if not, 0.0625 [1/16] inch, using rectified tiles of equal faces and dimensions.
e. Membrane: ANSI A 108.13

2. Preparation: Slope subfloors 0.25 inch to drain.
3. Installation of tile: ANSI A108.5.
4. Movement joints: Provide per EJ171.
5. Usage: Where shown, and tiled shower rooms, but not subject to water deluge, tiled bath floor floors.

3.3 INSTALLATION OF WALL TILE – NEW CONSTRUCTION

A. Thin-set: Comply with TCNA guide spec and the following:
1. Method: W244C – Cementitious backer.
a. Substrate: Cement mortar board.
b. Mortar: Latex-Portland cement, ANSI 118.4.
c. Grout: Polymer modified, ANSI A118.7.
d. Grout joints: Width indicated, if not, 0.0625 [1/16] inch, using rectified tiles of equal faces and dimensions.
e. Membrane: ANSI A 108.13, required for wet areas, with partial or complete deluge.
2. Preparation: Comply with method, install membrane.
3. Installation of tile: ANSI A108.5.
4. Movement joints: Provide per EJ171.
5. Usage: Where shown, and tiled shower rooms, tiled bath walls.

END OF SECTION

SECTION 09 30 50 – PREFABRICATED SHOWER BASES FOR TILED WALLS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section Includes, without limitation, providing:
1. Precast terrazzo base to receive wall tile or FRB.

C. Related Sections, without limitation, include:
1. Division 09 – Finishes, tiling, FRP, and the like.

1.2 SUBMITTALS

A. Comply with Division 01 General Requirements and submit for approval:
1. Product Data: Manufacturer's literature including installation instructions, use restrictions and limitations.
2. Shop drawings: Large scale drawings for fabrication, installation and erections including plans, elevations, details, anchorages, connections and accessories along with head, jamb, sill and joining details. Provide templates for work installed by others.
   a. Field Measurements: Take accurate field measurements before fabrication and indicate same on shop drawings.
3. Samples: Color and material ranges showing variation of color and finish, if any.
4. Initial Selection samples: Provide samples of color and material ranges.
5. Verification: Submit final samples of selected products. Include samples showing full variation of color and finish expected.
6. Maintenance Data: Provide recommended maintenance procedures.

B. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Comply with Division 01 requirements and governing codes and regulations.

B. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 TERRAZZO SHOWER BASE MANUFACTURERS

A. Subject to compliance with requirements, provide products from
1. Florestone; http://www.florestone.com/.
2. Acorn; http://www.acorneng.com/.
3. Fiat Products; http://www.fiatproducts.com/.
4. Approved equal.

B. Basis of design: Florestone Model 200 as well as Model 400 Barrier Free Shower Receptor.

2.2 TERRAZZO SHOWER BASES

A. Cementitious Terrazzo:
1. Portland cement: ASTM C 150, Type I.
2. Sand: ASTM C 33.
3. Aggregate: Sound crushed marble and glass chips complying with NTMA standards.
4. Matrix Pigments: Pure mineral or synthetic pigments, alkali resistant, color stable.

5. Strength: Minimum of 3000 psi after 7 days.
6. Underbed Reinforcement: Welded non-corrosive wire fabric, 2 by 2 inch, 16 gauge.
7. Isolation Membrane: Polyethylene film, 4 mils.
8. Auxiliary Materials:
   a. Terrazzo sealer.

B. Precast terrazzo shower bases:
1. Compliance standards: ICC ANSI A117.1, ADA, Fair Housing Act
2. Minimum 1 inch. thick, reinforced, Portland cement terrazzo units.
3. Comply with NTMA's written recommendations for fabricating precast terrazzo units in sizes and profiles indicated.
4. Size, shape: As shown. Provide custom sizes where shown and required.
5. Reinforce units as required by unit sizes, profiles, and thicknesses and as recommended by manufacturer.
6. Finish exposed-to-view edges and reveals to match face finish.
7. Ease exposed edges to at least 1/8-inch (3.2-mm) radius.
8. Shapes: Provide shapes indicated or required where offset drains are needed.
9. Tile reveal and integral hot dipped galvanized steel or stainless steel flange for flashing: Required.
10. Surface: Non-slip.
11. Integral drain: Required with removable grid strainer.
12. Pipe size connection: As required per plumbing documents.
13. Color, Pattern, and Finish: As selected by Architect from full range of industry colors and including matching existing.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the provisions of Section 01 70 00 - especially requirements related to:
1. Inspection and examination. Tolerances and measurement.
2. Approvals, inspections and filed quality control.
3. Layout. Adjusting.
4. Cleaning. Protection.

3.2 INSTALLATION

A. Comply with requirements of Division 01 and the following:
1. Inspect and prepare areas, assemblies and surfaces to receive work.
2. Verify conditions will permit an ADA compliant installation.
3. Starting work constitutes acceptances of conditions.
4. Where required, take field measurements prior to fabrication, where possible.
5. Form work to required shapes and sizes with true, straight edges, lines and angles. Provide light-tight, hairline joints.
6. Install work plumb, level, true, straight and free of distortions.
7. Install materials and systems in accordance with manufacturer's instructions, restrictions, limitations and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with work of other sections.
8. Coordinate with work of other sections; provide inserts and templates as needed. Install work plumb and level with uniform appearance.
9. Restore damaged finishes and protect work.

3.3 PRECAST TERRAZZO INSTALLATION

A. Install precast terrazzo units using method recommended NTMA and manufacturer unless otherwise indicated.

B. Installation Tolerance: Set units with alignment level and true to dimensions, varying 1/8-inch maximum in length, height, or width; noncumulative.

C. Do not install units that are chipped, cracked, discolored, or not properly finished.

D. Seal joints between units with joint compound matching precast terrazzo matrix

3.4 CLEANING

A. Cleaning:
1. Remove grinding dust from installation and adjacent areas.
2. Wash surfaces with cleaner according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow to dry thoroughly.

B. Sealing terrazzo: Seal precast units at fabricator's facility.
1. Seal surfaces according to NTMA's written recommendations.
2. Apply sealer according to sealer manufacturer's written instructions.

END OF SECTION

SECTION 09 51 10 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Lay-in mineral fiber panels.
2. Suspension systems.

C. Related Sections without limitation include:
1. Lighting fixtures and their independent suspension: Division 26 - Electrical.
2. HVAC diffusers: Division 23 – HVAC
3. Gypsum Wallboard: Section 09 29 00

1.2 QUALITY ASSURANCE

A. Installer: Firm with not less than three years of successful experience in installation of acoustical ceilings similar to requirements for this project and which is acceptable to manufacturer of acoustical units, as shown by current written statement from manufacturer.

B. Acceptable Manufacturers: As noted in paragraphs related to each product.

C. Tolerances:
1. Deflection: Suspension system components, hangers, and fastening devices and acoustical units; Maximum deflection 1/360th of the span. Deflection test: ASTM C635, current edition.
2. Allowable tolerance of finished acoustical ceiling systems; level to within 1/8" in 12'.

D. Flame Spread Ratings:
1. Acoustical Ceilings:
   a. Maximum flame spread: 0-25 (ASTM E 84)
   b. Fuel contributed: Class A (Fed. Spec. SS-5-118B)
   c. Smoke developed: 25 or less (U.L. Label)

1.3 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's product specifications and installation instructions for panels, trim, and suspension systems. Include certified laboratory test reports and other data as required to show compliance with these specifications. Previously performed test published in manufacturer's literature is acceptable. Include manufacturer's recommendations for cleaning and refinishing acoustical units, including precautions against materials and methods which may be detrimental to finishes and acoustical performance.

B. Samples:
1. Submit 2 sets of 12" square samples of each style of ceiling panel. In each set of samples show the full range of exposed color and texture to be expected in the completed work.
2. Submit two sets of 12" long samples of suspension system and edge moldings.
3. Submit two sets of 12" long samples of extruded trim and standard system accessories. Samples shall be and. Provide one radiused section and one 90 degree corner both split to show butted joint with splice plate and corner reinforcement.

C. Extra stock: 2 per cent of material installed.

D. Certificates:
1. Furnish certification of fire endurance rating and flame spread index from fire rating organization.
2. Furnish certification that materials and systems conform to specification requirements.

E. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.4 PRODUCT DELIVERY AND HANDLING

A. All ceiling system materials shall be delivered in manufacturer's original labeled cartons, indicating brand name, pattern, size, thickness and fire rating, and shall be suitably stored within the building and protected from damage until ready for installation.

1.5 JOB CONDITIONS

A. Do not install interior acoustical ceilings until space has been enclosed and is weather-tight, until wet-work in the space has been completed and is nominally dry, until work above ceilings has been completed, and until ambient conditions of temperature and humidity will be continuously maintained at values near those indicated for final occupancy.

B. Maintain humidity of 60% - 70% in area where acoustical materials are to be installed, 24 hours before, during, and 24 hours after installation.

C. Maintain uniform temperature in range of 55 to 70 degrees F prior to and during installation.

PART 2 - PRODUCTS

2.1 ACOUSTICAL CEILING SYSTEMS

A. Provide ceiling systems indicated in Finish Legend. Where none are indicated provide systems indicated below. In the event of conflict, the higher quality shall govern.

B. ACT – 1 Acoustic Panels for Dry Locations: Armstrong Ultima High NRC Tegular white model #1942 and #1944

C. ACT – 2 Acoustic Panels for Wet Locations: Armstrong Health Zone Ultima#1446, Tegular, White. (24” Square Panels).

D. Grid systems sizes: As shown, if not, 9/16 inch wide in white.

2.2 CEILING SUSPENSION MATERIALS

A. Exposed Suspension System: Provide manufacturer’s narrow and standard profile, exposed grid of commercial quality cold rolled, pre-treated, pre-finished electro-galvanized steel grid system complying with ASTM C-635 for Intermediate Duty direct hung double-web with flat (low gloss) off white baked enamel face and black or white interior. Provide grid modules to match ceiling panel sizes.

B. Provide products that meet or exceed specified requirements from one of the following:
1. Ecophon
2. Chicago Metallic Corp.
3. USG/Donn Corp.
4. National Rolling Mills.
5. Technical Ceiling Systems.

C. Provide all wall angles and accessories for a complete system in matching finish.
1. Provide factory formed, shop formed or when approved, field formed break metal of approved color to shapes shown.

D. Performance of system:
1. The Suspension System shall support the ceiling assembly on the drawing, or specified herein, with a maximum deflection of 1/360 of the span, in accordance with intermediate duty classification.
2. The suspension system shall lock together in a positive manner providing pull out values in tension of 300 lbs. or greater. Provide seismic bracing where ceilings exceed threshold size for same.
3. Hanger wires: Galvanized carbon steel, ASTM A641, soft temper, pre-stretched, yield-stress load of at least 3 times design load, but not less than 12 gauge (0.106"). Wires must be sized and spaced to meet the criteria of this Section, and applicable codes. Provide wire in bundles of straight sections and not in coils.

4. Attachment devices: Provide units sized for 5 times design load for direct hung in Table 1 per ASTM C635.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION

A. Examine the conditions under which the acoustical ceiling and trim work is to be performed. Do not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner. Notify construction manager in writing of any unacceptable conditions. Starting work in any area constitutes acceptance of conditions in that area.

B. Layout of ceiling shall comply with the reflected ceiling plans. Ask for Architect's direction if discrepancies or omissions exist in the plan.

3.2 INSTALLATION OF ACOUSTICAL CEILINGS

A. General: Install materials in accordance with manufacturer's printed instructions and to comply with governing regulations, fire resistance rating requirements as indicated, and industry standards applicable to the work.

B. Arrange acoustical units and orient directionally-patterned units (if any) in the manner shown by reflected ceilings plans. Install tile with pattern running in one direction. Where discrepancies in the field do not permit intended installation notify the Architect for direction.

C. Install suspension systems to comply with ASTM C-636, with main runners 48" o.c. and with hangers near each end and spaced as required to meet the criteria herein specified. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eye-screws, or other devices which are secure and appropriate for the substrate, and which will not deteriorate or fail with age or elevated temperatures. Do not splay wire more than 5" in 4 feet vertical drop.

D. Install manufacturer's standard edge moldings or, if drawn, supply the type indicated, at edges of each acoustical ceiling area, and at locations where edge of units would otherwise be exposed after completion of the work.

E. Secure moldings to building construction well by fastening with screw-anchors into the substrate, through holes drilled in vertical leg. Space holes not more than 3 inches from each end and not more than 16 inches o.c. along each molding.

F. Corners shall be neatly and tightly butted or mitered and securely connected to prevent dislocation.

G. Install acoustical panels in coordination with suspension system with edges concealed by support of suspension members.

H. Acoustical units: Install in level plane in straight line courses.
1. Place units to bear all around suspension members.
2. Minimum width of border tiles: one-half unit dimension, unless pattern shows otherwise.
3. When units must be cut to less than full size, cut side shall be precisely cut with reveal edge equal to other reveal edge sides.framing at locations designated on the reflected ceiling plans.

I. Air supply and return (and support frames) units shall be installed in the framing at locations designated on the reflected ceiling plans.

A. Erect system according to manufacturer recommendations to achieve optimum results, approved shop drawings and these specifications. Erect components plumb, plane and true to shapes, lines and radii shown. Joints shall be straight, clean, and hairline, free of gaps, knicks, ragged egdes or out-of-aligment elements.

B. Note: The system has been designed to eliminate the need for field cutting. Obtain written approval before making field cuts.

A. Inspect existing ceilings to remain. Replace cracked, damaged or soiled tiles with new work to match.

3.3 CLEANING AND PROTECTION

A. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings and suspension members. Comply with manufacturer's instructions for cleaning and touch-up of minor finish damage. Remove and replace work which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

B. Protection of installed materials is specified elsewhere in the General Conditions. Provide information on measures and requirements necessary to protect acoustical ceilings from damage, including damage from excessive temperature and humidity, so that work will be without damage and deterioration at the time of acceptance by the Owner.

C. Remove debris, cartons and rubbish from work areas daily as work progresses.

D. Repair or replace any work of other trades damaged by the installation of the work of this Section.

END OF SECTION

SECTION 09 65 10 - RESILIENT BASE

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitations providing:
1. Resilient wall base.

1.2 QUALITY ASSURANCE

A. Installer Qualifications: Minimum 5 years experience installing resilient flooring.

B. Verify substrate conditions and suitability by carrying out adhesion tests.

C. VOC Washington State IAQ Test per ASTM D5116.

D. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
2. Smoke density: Compliance with code but less than 450 per NFPA 258 / ASTM E 662.

E. Mock-ups: Mock-ups shall included transition assemblies and components to demonstrate that adjoining surfaces and materials are flush. Provide mock-ups of all material conditions abutting resilient flooring.

1.3 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's descriptive brochures and installation instructions for each type of resilient flooring and accessory.

B. Samples Submit 2 chains or boxes of small color samples illustrating entire line of material proposed for base.

C. After initial color choice has been made by Architect, submit 2 sets of full size samples at least 12 inches long of each type to be used.

D. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.4 PRODUCT DELIVERY AND STORAGE

A. Compl with provisions of Product Requirements Division 1 and the following:
1. Unless otherwise directed, store materials in original containers at not less than 70` F for not less than 24 hours immediately before installation.

1.5 JOB CONDITIONS

A. Areas to receive flooring shall be heated to between 65 degrees F. and 90 degrees F. for at least 48 hours prior to installation. Maintain 65 degree F. temperature continuously during and after installation as recommended by flooring manufacturer, but for not less than 48 hours. Thereafter do not allow ambient temperature to fall below 55 degrees F.

B. Verify age and extent of cure of masonry or concrete.

1.6 ADDITIONAL MATERIALS

A. Base: Provide one full box of 100 linear feet minimum or 1/2% of total linear footage installed, whichever is greater, in each style and color of resilient base installed. Provide in manufacturer's original unopened boxes plainly labeled with description of contents. Do not furnish scrap.

1.7 WARRANTY

A. Warrant products as given below. Provide manufacturer's standard warranty equal to or better than times given below and/or warrant materials as follows:
Wall base: 2 years limited warranty.

PART 2 - PRODUCTS

2.1 VINYL RESILIENT BASE

A. Refer to Finish Material Legend and provide scheduled units.

B. Provide 1/8 inch PVC vinyl base at vinyl composition tile, and at locations indicated, complying with Federal Spec SS-W-40a Type II Class 1, Styles A and B of 1st quality, smooth and free of imperfections. Provide base of 100 foot roll material in continuous lengths. Base shall comply with the following:
1. Height: As shown, if not indicated, 4 inches
2. Typical & Carpet Style: Straight toe
3. Style at VCT: Top-set standard cove toe
4. Manufacturer: Johnsonite or Roppe.
5. Typical Color: As selected or shown.

2.2 ACCESSORIES

A. Sustainable & "Green" products: Use products complying with Sustainable design requirements and meeting manufacturer conditions.

B. Adhesives (Cements): Waterproof, stabilized type as recommended by flooring manufacturer. Asphalt emulsions and other non-waterproof types not acceptable. Where manufacturer insists on use of their adhesives for warranties to be effective, use only their products.

C. Comply with provisions of Division 01 and the following VOC levels:
1. Cove base adhesives: 50 g/L.

PART THREE - EXECUTION

3.1 INSTALLATION OF RESILIENT BASE AND ACCESSORIES

A. Comply with the following: Section 09 65 50 – Resilient Flooring Installation.

END OF SECTION

SECTION 09 65 14 .2 - VINYL PLANK FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: All the Contract Documents and provisions, and Division 1 General Requirements apply to the work of this Section.

B. Section includes, without limitations, providing:
1. Vinyl plank flooring

C. Related work:
1. Division 3 – Concrete & Cementitious assemblies.
2. Section 09 65 10 – Resilient base.
3. Section 09 65 50 – Resilient flooring installation.

1.2 QUALITY ASSURANCE

A. Comply with sectin 09 65 50.

1.3 SUBMITTALS

A. Comply with provisions of Division 1 and submit the following:
1. Manufacturer's Data: Submit manufacturer's descriptive brochures and installation instructions for each type of resilient flooring and accessory.
2. Samples: Submit 2 chains or boxes of small color samples illustrating entire line of material proposed for flooring and base.
3. After initial color choice has been made by Architect, submit 2 sets of full size samples at least 12 inches long of each type to be used.
4. Mark samples with name of contractor, project identification and area where materials are to be used. Also include the manufacturer's complete identification of his product.

B. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.4 QUALITY ASSURANCE

A. Comply with section 09 65 50.

1.5 PRODUCT DELIVERY AND STORAGE

A. Comply with Product Requirements of Division 1 and the following:
1. Unless otherwise directed, store materials in original containers at not less than 70` F for not less than 24 hours immediately before installation.

1.6 JOB CONDITIONS

A. Comply with section 09 65 50.

1.7 ADDITIONAL MATERIALS

A. Sheet goods: Provide one full roll of sheet material or 1% of the total area of resilient floor installed, whichever is greater, of each pattern and color installed, for future maintenance requirements. Furnish extra stock in manufacturer's original unopened rolls plainly marked with product number, shade, pattern and location within Project where installed.

B. Accessories: Provide 100 linear feet or 1/3% of total linear footage installed, whichever is greater, of each style and color of resilient accessory installed. Provide in original boxes, plainly labeled, and in original uncut lengths. Do

not furnish scrap.

1.8 WARRANTY

A. Warrant products as given below. Provide manufacturer's standard warranty equal to or better than times given below and/or warrant materials as follows:
Sheet goods: Manufacturer's standard.

PART 2 - PRODUCTS

2.1 VINYL PLANK FLOORING – LOW VOC

A. Provide commercial grade sheet flooring equal or better than criteria given below and as scheduled on drawings.
1. Material: Low VOC
2. Overall Gage: 0.120 inch thick minimum.
3. Wear layer: 0.020 inch thick minimum.
4. Edge treatment: Square.
5. Surface treatment: Emboss based upon product selected.
6. Static load: 250 psi minimum.
7. Standard: ASTM F1700, Class II, Type B, meet or exceed.
8. Critical Radiant Flux: Meet Class I, 045 watts/sq.cm or less.
9. Slip resistant: ADA compliant.
10. Substrate application: Verify manufacturer acceptance.
11. Tile: Where and size shown.

2.2 ACCESSORIES, UNDERLAYMENT & LEVELING COMPOUNDS

A. Comply with Section 09 65 50.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the provisions of Section 01 70 00 and Section 09 65 50 - especially requirements related to:
1. Inspection and examination. Tolerances and measurement.
2. Approvals, inspections and filed quality control.
3. Layout. Installation.
4. Polishing. Cleaning.
5. Protection.

END OF SECTION

SECTION 09 65 15 - RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: All the Contract Documents and provisions, including the Drawings, and Division 1 General Requirements apply to the work of this Section.

B. Section includes, without limitations, providing:
1. Vinyl sheet flooring.
2. Slip resistant flooring.
3. Integral cove installation where shown or scheduled.

C. Related work:
1. Division 3 – Concrete & Cementitious assemblies; including floors sloped to drains.
2. Section 09 65 10 – Resilient base.
3. Section 09 65 50 – Resilient flooring installation.

1.2 QUALITY ASSURANCE

A. Comply with section 09 65 50.

1.3 SUBMITTALS

A. Comply with provisions of Division 1 and submit the following:
1. Manufacturer's Data: Submit manufacturer's descriptive brochures and installation instructions for each type of resilient flooring and accessory.
2. Samples: Submit 2 chains or boxes of small color samples illustrating entire line of material proposed for flooring and base.
3. After initial color choice has been made by Architect, submit 2 sets of full size samples at least 12 inches long of each type to be used.
4. Mark samples with name of contractor, project identification and area where materials are to be used. Also include the manufacturer's complete identification of his product.

B. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.4 PRODUCT DELIVERY AND STORAGE

A. Comply with Product Requirements of Division 1 and the following:
1. Unless otherwise directed, store materials in original containers at not less than 70` F for not less than 24 hours immediately before installation.

1.5 JOB CONDITIONS

A. Comply with section 09 65 50.

1.6 ADDITIONAL MATERIALS

A. Sheet goods: Provide one full roll of sheet material or 1% of the total area of resilient floor installed, whichever is greater, of each pattern and color installed, for future maintenance requirements. Furnish extra stock in manufacturer's original unopened rolls plainly marked with product number, shade, pattern and location within Project where installed.

B. Accessories: Provide 100 linear feet or 1/3% of total linear footage installed, whichever is greater, of each style and color of resilient accessory installed. Provide in original boxes, plainly labeled, and in original uncut lengths. Do

not furnish scrap.

1.7 WARRANTY

A. Warrant products as given below. Provide manufacturer's standard warranty equal to or better than times given below and/or warrant materials as follows:
Sheet goods: Manufacturer's standard.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specifications, provide products from:
1. Armstrong Industries.
2. Altro
3. Manningnton.

B. Basis of design: As scheduled, if not, Armstrong Medintech, with heat welded seams.

2.2 FINISH LEGEND OR FINISH DESCRIPTIONS

A. Provide products listed or scheduled or approved equals. If not comply with the specfications below for the types required.

2.3 HOMOGEOUS SHEET VINYL FLOORING

B. Provide product listed in finish legend, if not, complying with the following:
1. Product: Institutional / medical grade sheet, with heat welded seams.
2. Material standard: ASTM F1913, and ISO 10581, Type 1.
3. Resistance to Mold/Mildew (ASTM G2 1/E2180: Passes.
4. Product type: Suitable for medical, hospital and a-septic environments.
5. Size: Wide 79 inches x 98.4 feet long.
6. Gage: 0.080 inch.
7. Wear layer: 0.080 inch.
8. Warranty: 10 year commercial limited.
9. Adhesive: Manufacturer recommended type for application.
10. Welding rods: Solid for a-septic spaces, Architect selected elsewhere.

C. Configuration: Integral cove and self forming base.

D. Accessories:
1. Vinyl welding rod: Acceptable material: As recommended by manufacturer for the application.
2. Cove former: Acceptable material, sized to suit application.
3. Cap strip: Acceptable material, sized to suit application, of either Vinyl or stainless steel.
4. Joint cover strip: Acceptable material, vinyl, sized to suit application.
5. Metal edge strips: Stainless steel Aluminum extruded, smooth, [mill finish] stainless steel with lip to extend under floor finish, shoulder flush with top of adjacent floor finish.

2.4 ACCESSORIES, UNDERLAYMENT & LEVELING COMPOUNDS

A. Comply with Section 09 65 50.

PART 3 - EXECUTION

3.1 PREPARATION, INSPECTION & INSTALLATION

A. Comply with Section 09 65 50.

3.2 CLEANING, POLISHING AND PROTECTION

A. Comply with Section 09 65 50.

3.3 CLEAN UP

A. Remove from the job site and legally dispose of all cartons, cans, and rubbish resulting from the work of this Section. Restore or replace any finished exposed surface soiled by the work of this Section.

END OF SECTION

SECTION 09 65 50 - RESILIENT FLOORING INSTALLATION

PART 1 GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Resilient flooring installation
2. Floor preparation.
3. Leveling & flash patching.
4. Slab testing.

C. Related work:
1. Division 03 – Concrete & Cementitious assemblies.
2. Division 09 – Resilient flooring

1.2 SUBMITTALS

A. Comply with provisions of Division 1 and submit:
1. Manufacturer's Data: Submit manufacturer's descriptive brochures and installation instructions for each type of resilient flooring installation materials and accessories.
2. Test results: Provide moisture content readings and test results in writing.
3. Attic Stock: Comply with Section 01 78 00.

B. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Minimum 5 years experience installing resilient flooring.

B. Verify substrate conditions and suitability by carrying out adhesion tests of resilient flooring bond to substrate aas recommended by Armstrong in their installation system manual F-5061 and Moisture meter testing per ASTM F2170-02 Follow tile and adhesive manufacturer recommendations for performing test patches. Comply with testing requirements specified here.

C. Prior to start of construction, coordinate with concrete work to ensure no concrete curing agents, sealers, hardeners, or parting agents will be used in areas to receive resilient flooring.

D. VOC Washington State IAQ Test per ASTM D5116.

E. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
2. Smoke density: Compliance with code but less than 450 per NFPA 258 / ASTM E 662.

F. Mock-ups: Mock-ups shall included transition assemblies and components to demonstrate that adjoining surfaces and materials are flush. Provide mock-ups of all material conditions abutting resilient flooring.

1.4 PRODUCT DELIVERY AND STORAGE

A. Comply with provisions of Division 01.
1. Deliver materials to project site in manufacturer's original, unopened containers with labels indicating brand names, colors and patterns and quality designations legible and intact.
2. Do not open containers or remove markings until materials are inspected and accepted.
3. Store and protect accepted materials in accordance with manufacturer's directions and recommendations.
4. Unless otherwise directed, store materials in original containers at not less than 70` F for not less than 24 hours

immediately before installation.

1.5 JOB CONDITIONS

A. Areas to receive flooring shall be heated to between 65 degrees F. and 90 degrees F. for at least 48 hours prior to installation. Maintain 65 degree F. temperature continuously during and after installation as recommended by flooring manufacturer, but for not less than 48 hours. Thereafter do not allow ambient temperature to fall below 55 degrees F.

B. Verify age and extent of cure of concrete slabs.

PART 2 PRODUCTS

2.1 MATERIALS

A. Basis of Design is as indicated on the Finish Product List, as selected by Architect from manufacturer's full range. Refer to individual product specification sections for pertinent product information.

2.2 PRODUCTS

A. Manufacturer requirements: Use products acceptable to and meeting manufacturer recommendations, limitations and requirements for each application as appropriate. Where manufacturer considers application unique or restricted to specific installation product, use only product indicated in manufacturer literature

B. Sustainable & "Green" products: Use products complying with Sustainable design requirements and meeting manufacturer conditions.

C. Adhesives (Cements): Waterproof, stabilized type as recommended by flooring manufacturer. Asphalt emulsions and other non-waterproof types not acceptable. Where manufacturer insists on use of their adhesives for warranties to be effective, use only their products.

D. Concrete Slab Primer and Crack Filler: Non-staining type as recommended by flooring manufacturer.

E. Floor cleaner: Commercial floor cleaner as recommended by flooring manufacturer such as "C-410" by Armstrong, Flintkote "Floor Cleaner" or Hillyard "Super Shine-All".

F. Floor sealer: Commercial floor cleaner as recommended by flooring manufacturer such as "C-410" by Armstrong, Flintkote "Floor Cleaner" or Hillyard "Super Shine-All".

2.3 UNDERLAYMENT & LEVELING COMPOUNDS

A. Latex Underlayment: As recommended for use on concrete floors by resilient flooring manufacturers and equal to Armstrong "S-105", Silpro "Pro-Finish" or "Lev-L-Astic" by Allied.

B. Cementitious leveling materials: Provide materials suitable for application depending upon conditions such as existing unacceptable slabs, or wood flooring or cut-back mastics. Appropriate products include: "Masco Latex Cement" latex admix", "Mascrete Latex Flooring Cement", "Silflo 200 Self-Leveler" mixed with C-21 Acrylic, all by Silpro Masonry Systems of Ayer MA or comparable products by Ardex Inc. or approved equals. Provide products which can be feathered to zero and either trowel applied or self-leveling.

2.4 RESILIENT & INSTALLATION ACCESSORIES

A. Edge strips, guards, reducers: Comply with the following:
1. Finishing components: Molded or extruded hard rubber to match conditions.
2. Manufacturers: Roppe Corp, Johnsonite Inc., Mercer Plastic or approved equal.
3. Material: 1st quality rubber free of imperfections.
4. Shape: 1/8 inch or thicker, tapered or bullnose edge.
5. Color: As selected by Architect.
6. Size: Not less than 1" wide.
7. Locations: At perimeter of resilient flooring abutting different floor material.
8. Sizes and shapes: As required to meet other adjacent floor materials such as carpet.
9. Provide 1st quality rubber free of imperfections.

B. Metal Edge strips: Units by Schluter, suitable for application to ensure smooth transitions.
   1. Alternative manufacturers: Blanke corporation; Ceramic Tool Co. Inc.

PART 3 EXECUTION

3.1 INSPECTION & TESTING

A. Examine the areas and conditions under which resilient flooring and accessories are to be installed. Ensure slabs are sufficiently cured. Notify construction manager in writing of any unsatisfactory conditions with are not covered as part of the work of this section.

B. Verify that subfloors/underlayments are dry, clean and smooth, and are free of paint, varnish, excessive adhesive residues, solvents, wax, oil and other foreign matter. Do not proceed with installation of resilient flooring if conditions exist which would impair the timely completion or satisfactory performance of the completed installation.

C. Use manufacture recommend moisture meters or carry out specified bond tests.

D. Perform tests to ensure slabs and cementitious underlayments are free of any moisture which could adversely affect bonding of resilient materials to substrate. And the following:
   1. Test substrates and submit results in writing along with manufacturer maximum recommended moisture recommendations for finishes being applied
   2. Moisture Testing/ chloride testing: Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates do not exceed a maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
   3. Moisture meter testing: Comply with ASTM F2170-02 Probe Test for determining relative humidity. Use Wagner Rapid RH probes, unless otherwise approved.
   4. Radio Frequency testing: Where requested, or required, test floor slabs in compliance with ASTM F2170-02 Radio Frequency Method.

E. Alkalinity: Test pH and comply with manufacturer recommendations and requirements. Perform pH tests on concrete floors regardless of the age or grade level. If pH is greater than manufacture requirements, neutralize slab before beginning installation. In general pH requirements included:
   1. Enhanced vinyl tile: pH range of 7 and 9.
   2. Flocked resilient floors: pH less than 10.
   3. Other floors: As per manufacturer.

F. For rigid long span resilient plank units: Measure floor and slab flatness and levelness according to ASTM E 1155 and submit results in writing.

G. Beginning work **shall constitute acceptance** of substrate surfaces as satisfactory for proper installation of resilient materials.

3.2 PREPARATION

A. Prepare substrates according to ASTM F710, and the provisions below.

B. New construction: Verify that floors are constructed to specified tolerances with no variation greater than 1/8 inch in 10 feet; ensure concrete slabs are 21 days old or older and up to required strengths.

C. Verify existing floor conditions to receive resilient flooring. As part of the work of this Section correct imperfections, dips and rises with suitable underlayment of approved type.

D. Floors to receive resilient flooring shall be finished even and level. Plane and flatness of floor shall be free of perceptible changes of level or line which in the opinion of the Architect adversely affect the appearance or function of the work.

E. Fill all cracks in subsurfaces with specified crack filler.

F. Apply latex underlayment at intersections of resilient flooring with carpet and where required to comply with specified requirements. Taper for a minimum length of 3 feet from the intersection joint. Finished application shall permit a smooth, level intersection of carpet and resilient surfaces.

G. Prior to laying flooring, broom clean **and vacuum** surfaces to be covered. Remove dirt, oil, grease, sand, particles, bumps, ridges and surface imperfections or other foreign matter from surfaces to be covered.

3.3 RESILIENT FLOORING INSTALLATION PROCEDURES - GENERAL

A. Install materials in accordance with Armstrong's "Guaranteed Installation Systems Guide Product F-5061" current edition, and these specifications and applicable manufacturers' instructions, and as follows:
1. Install flooring after finishing operations, including painting have been completed and permanent heating system is operating. Moisture content of concrete slabs, building air temperature and relative humidity must be within limits recommended by flooring manufacturer.
2. Place flooring with adhesive cement in strict compliance with manufacturer's recommendations. Butt tightly to vertical surfaces, thresholds, nosings and edgings. Scribe as necessary around obstructions and to produce neat joints, laid tight, even, and straight. Extend flooring into toe spaces, door reveals, and into closets and similar openings.
3. Maintain reference marks, holes or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other non-permanent marking device.
4. Install flooring on covers for telephone and electrical ducts, and other such items as occur within finished floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed in these covers. Tightly cement edges to perimeter of floor around covers and to covers.
5. Tightly cement flooring to subbase without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections.

3.4 LAYING TILE

A. Comply with manufacturer recommendations and the following:
1. Lay tile from center marks established with principal walls, discounting minor offsets, so that tile at opposite edges of the room are of equal width. Adjust as necessary to avoid use of cut widths less than 3" at room perimeters. Lay tile square to room axis, unless otherwise shown.
2. Match tiles for color and pattern by using tiles from cartons in same sequence as manufactured and packaged. Cut tile neatly to and around all fixtures. Broken, cracked, chipped or deformed tile are not acceptable.
3. Lay tile with grain in tile running in the same direction, unless otherwise directed by Architect.
4. Feature strips and borders: Where required, shown, scheduled, specified or indicated, install contrasting colored strips or borders. Make borders true in line and consistent in layout.

B. Laying conductive tile: Comply with manufacturer recommendations and the following:
1. Install using epoxy adhesive acceptable to manufacturer for application.
2. Ensure system is grounded using copper foil strip embedded in conductive epoxy adhesive and extended beyond perimeter to connect to building equipment grounding conductor per the manufacturer's instructions.

3.5 LAYING SHEET GOODS

A. Allow product to relax before starting installation.

B. Lay sheet goods using method to produce best results for the application such as direct, straight, or pattern scribing. Match patterns and shapes indicated, if any. Provide feature strips and borders where required. Check squareness of space. Do not layout more adhesive than necessary for the time available to lay work. Verify seaming method appropriate to material being used; check edge thicknesses to ensure good match. Ensure full adhesion across entire face. Conduct work to prevent unnecessary traffic over floor during and after installation.

3.6 INSTALLATION OF RESILIENT BASE AND ACCESSORIES

A. Comply with the following:
1. Apply resilient base to walls, columns, pilasters, casework and other permanent fixtures in rooms or areas where base is required. Install base behind back and sides of equipment not build into place. Install base in as long lengths as practicable, using rolls. Tightly bond base to backing throughout the length of each piece, with continuous contact at horizontal and vertical surfaces. Install with tight butt joints with no joint widths greater than 1/64 in.
2. On masonry surfaces, or other similar irregular surfaces, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.

3. Top-set base: Apply adhesive and firmly adhere to wall surfaces. Press down so that bottom cove edge follows floor profile. Form corners by heat bending. Scribe base accurately to abutting materials.
4. Place resilient edge strips tightly butted to flooring and secure with adhesives. Install edging strips at all unprotected edges of flooring unless otherwise shown.
5. Immediately clean excess adhesive from all and floor surfaces.

3.7 CLEANING, POLISHING AND PROTECTION

A. Comply with manufacturer recommendations. Do not clean, polish or wax tiles where manufacturer does not recommend same. In general, comply with the following:
1. Setting Period: Allow resilient flooring to set for at least five days without traffic before beginning cleaning operations.
2. Cleaning: At end of setting period, wash resilient floors with diluted commercial floor cleaner and rinse thoroughly. Clean off all product labels, footprints and other dirt or marks.
3. Initial Waxing: Apply two coats of buffable commercial floor wax, of a kind recommended by flooring manufacturer for VCT and applicable products, and buff to a high shine.
4. Initial Sealing for rubber/cork tile: Apply coats as recommended by manufacturer.

B. Protection: Protect resilient flooring until acceptance.

C. Maintenance: Instruct Owner personnel of proper maintenance procedures for all installed products.

END OF SECTION

SECTION 09 67 23 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section Includes, without limitation, providing:
1. Resinous flooring.
2. Integral base.
3. Aggregate matrix system.
4. Non-slip surface and topping.

C. Related requirements includes, without limitation:
1. Section 03 30 00 - Cast in place concrete.

1.2 SYSTEM DESCRIPTION

A. System generally consists of:
1. Preparing substrate.
2. Applying a cementitious 100% solids epoxy based seamless flooring.
3. Quartz aggregate broadcast and epoxy based multi-roller flooring system with urethane topcoat.
4. Architect selected color and texture.
5. Integral cove base.
6. Non-slip finish.

1.3 SUBMITTALS

A. Comply with Division 01 General Requirements and submit for approval:
1. Product Data: Manufacturer's literature including installation instructions, use restrictions and limitations.
2. Shop drawings: Layout of area to be finished showing any required expansion joints, construction joints and cove base assembly. Show all termination details and any floor drain connections.
3. Initial Selection samples: Provide samples of color and material ranges, not less than 6 inches square and showing system thickness and all system components.
4. Verification: Submit final samples of selected products. Include samples showing full variation of color and finish expected.
5. Maintenance Data: Provide recommended maintenance procedures.
6. Certification: Certify submitted materials comply with requirements.
7. Certification: Certify substrate moisture content, condition and capacity is acceptable.

B. Field Moisture Test Reports: Submit anhydrous calcium chloride testing according to ASTM F 1869-98.

C. Mock-Up/Field Samples: Prior to installation, provide mock up of each type of system proposed for use for approval. Accepted mock-ups may be incorporated into the work unless otherwise noted.

D. Product Test Reports: Submit manufacturer's certified independent lab test reports not more than 2 years old documenting product performance.

E. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.4 QUALITY ASSURANCE

A. Manufacturer experience: Not less than 10 years experience in manufacture and support of cementitious urethane, polyurethane industrial flooring.

B. Applicator: Approved by manufacturer for surface preparation and application of specified product.

C. Regulatory approvals and compliance required:

1. United States Department of Agriculture (USDA), Food, Drug Administration (FDA), and local Health Department.
2. Certified: "High Traction" by the National Floor Safety Institute (NFSI)

D. Pre-installation conference: Held at site to review specifications, application procedure, quality control, inspection and acceptance criteria.

1.5 PRODUCT REQUIREMENTS

A. Comply with product requirements, delivery storage and handling provisions of Division01 and the following:
1. Do not deliver panels until job is ready for installation.
2. Store products in ventilated dry area; protect from dampness, freezing, and direct sun light.
3. Maintain temperatures below 85 °F and above 60 °F.
4. Prevent breakage of containers.
5. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
6. Packaging: Manufacturer's packaging, clearly identified with the product type and batch number.

1.6 PROJECT CONDITIONS

A. Site Requirements
1. Provide air, material and substrate temperatures between 60 F and 85 F providing substrate temperature is above its dew point. Outside of this range, consult Manufacturer in writing.
2. Relative humidity: Maintain 24 hours before and after installation less than 85% and surface temperature shall be at least 5 degrees F above dew point.
3. Provide lighting equal to final lighting level during the preparation and installation of system.

B. Conditions of new concrete to be coated with cementitious urethane material.
1. New concrete: Moisture cured for 7 days minimum and have fully cured for 28 days in accordance with ACI-308 prior to the application.
2. Conduct moisture tests of surfaces no sooner than 28 days after concrete installation and within 3 days of coating application.
3. Outside of these parameters consult manufacturer in writing.
4. Concrete finish: Flat rubbed finish, float or light steel trowel finish.
5. Concrete with hard steel trowel finish: Not permitted for application.
6. Sealers and curing agents shall not to be used.
7. Concrete slabs on grade without vapor barriers below: Consult manufacturer in the acceptability of using moisture suppressant coatings.

C. Safety requirements:
1. Remove open flames and spark-producing equipment from work area prior to beginning application.
2. Post "No Smoking" signs at entrances to work area.
3. Keep non-related personnel in work area to a minimum.

1.7 SEQUENCING & SCHEDULING

A. Ensure new and existing concrete surfaces are clean and properly prepared in time for surfaces to be sufficiently dry and cured for proper application for flooring.

PART 2 - PRODUCTS

2.1 BASIS OF DESIGN / MANUFACTURER

A. Acceptable manufacturers and fabricators, subject to compliance with specifications, include:
1. Dur-A-Flex, Inc., http://www.dur-a-flex.com/.
2. The Stonehard Group; https://www.stonhard.com/.
3. Latticrete; www.latticrete.com/.
4. Silikal; www.silikalamerica.com/.

B. Basis of design:

1. Dining areas: Dur-A-Quartz multi-colored quartz aggregate fused with clear 100% solids epoxy in grade selected by Architect from one of the following:
   a. Q28 fine.
   b. Q11 coarse.

C. System components / Dur-A-Quartz system:
1. Primer: Dur-A-Flex, Inc, Dur-A-Glaze #4 WB resin and hardener.
2. Broadcast Coats: Dur-A-Flex, Inc, Dur-A-Glaze #4 resin and hardener.
3. Quartz aggregate: Dur-A-Flex, Inc. Q-28 or Q-11 colored quartz aggregate.
4. Grout Coat: Dur-A-Flex, Inc. Dur-A-Glaze #4 resin and Water Clear hardener.
5. Topcoat: Dur-A-Flex, Inc. Armor Top resin, hardener and grit.
6. Patch materials:
   a. Shallow Fill and Patching: Dur-A-Glaze # 4 Cove-Rez (up to ¼ inch).
   b. Deep Fill and Sloping Material: Dur-A-Crete (over ¼ inch).

D. Moisture mitigation: Where moisture of system does not meet criteria, and subject to express, written approval of system manufacturer, provide manufacturer' recommended system such as Dur-A-Glazed MVP Primer.

2.2 PERFORMANCE REQUIREMENTS

A. Meet or exceed the following:

CRITERIA	*TEST*	*RESULT*
Broadcast and grout coats		
Percent solids	Percent solids	100%; 56% for primer
VOC	VOC	3.8 g/L; 2 g/L for primer
Bond Strength to Concrete	ASTM D 4541	550 psi, substrates fails [primer only]
Compressive Strength	ASTM C 695	17,500 psi
Flexural strength	ASTM D 790	5,100 PAI
Flame spread	ASTM E 84	CLASS A
Water absorption	MIL D-24613	Nil
Tensile Strength	ASTM D 638	2,100 psi
Impact Resistance @ 125 mils	MIL D-24613	0.0007 inch no cracking nor delamination
Topcoat [Amor Top]		
Percent Solids		95%
VOC		0 g/L
Tensile Strength	ASTM D 638	7,000 psi
Adhesion	ASTM D 4541	Substrate failure
Abrasion Resistance	ASTM D 4060	10 mg loss CS-17 wheel, 1,000g load, 1,000 cycles
Hardness,	ASTM D 3363	4H
Gloss	ASTM D 523	40-50 Satin Appearance

B. Non-slip performance: When wet system shall meet or exceed: A tested coefficient of friction when wet of 0.60 or higher. When dry, system shall meet European coefficient of friction of R12 or better.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the provisions of Division 01 - including requirements related to:
1. Inspection. Tolerances and measurement.
2. Approvals, inspections and filed quality control.
3. Layout. Adjusting.
4. Cleaning. Protection.

3.2 EXAMINATION

A. Examine and verify conditions per Division 01 and as follows:
1. Verify substrates and underlying work is within tolerances specified.
2. Verify structural components are properly placed.
3. Before installation, examine rough-in and built-in construction for mechanical/electrical and other systems to verify actual locations of connections.
4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

A. New and existing concrete surfaces shall be free of oil, grease, curing compounds, loose particles, moss, algae growth, laitance, friable matter, dirt, and bituminous products.

B. Moisture Testing: Perform tests recommended by manufacturer and as follows.
1. Perform relative humidity test using is situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 95% relative humidity level measurement.
2. If the relative humidity exceeds 95% then the Owner and/or Engineer shall be notified and advised of additional cost for the possible installation of a vapor mitigation system that has been approved by the manufacturer or other means to lower the value to the acceptable limit.

C. There shall be no visible moisture present on the surface at the time of application of the system. Compressed oil-free air and/or a light passing of a propane torch may be used to dry the substrate.

D. Mask and protect areas, surfaces and openings not part of this work from adverse affections of preparation and installation

E. Mechanical surface preparation Shot blast all surfaces to receive flooring system with a mobile steel shot, dust recycling machine (Blastrac or equal). All surface and embedded accumulations of paint, toppings hardened concrete layers, laitance, power trowel finishes and other similar surface characteristics shall be completely removed leaving a bare concrete surface having a minimum profile of CSP 4-5 as described by the International Concrete Repair Institute.
1. Floor areas inaccessible to the mobile blast machines shall be mechanically abraded to the same degree of cleanliness, soundness and profile using diamond grinders, needle guns, bush hammers, or other suitable equipment.
2. Wherever a free edge will occur, including doorways, wall perimeters, expansion joints, columns, doorways, drains and equipment pads, a ¼ inch deep by 3/16 inch wide keyways shall be cut in.
3. Cracks and joints (non-moving) greater than 1/4 inch wide are to be chiseled or chipped-out and repaired per manufacturer's recommendations.
4. At spalled or worn areas, mechanically remove loose or delaminated concrete to a sound concrete and patch per manufactures recommendations.

3.4 APPLICATION

A. General: Apply system in 7 distinct steps as follows:
1. Substrate preparation
2. Priming
3. First broadcast coat application with first aggregate broadcast
4. Second broadcast coat with second aggregate broadcast
5. Grout coat application, sand floor (if required)
6. First topcoat application
7. Second topcoat application

B. Application start-up:
1. Immediately prior to application of system components, dry surfaces and remove dust and loose particles with vacuum or clean, dry, oil-free compressed air.
2. Handle, mix and add components to achieve desired results and per manufacturer's recommendations.
3. Follow substrate contour pitching or leveling surface.

C. Primer:

1. The primer shall consist of a liquid resin and hardener that is mixed at the ratio of 1 part resin to 4 parts hardener per the manufacturer's instructions.
2. The primer shall be applied by 1/8 inch notched squeegee and back rolled at the rate of 200 sf/gal to yield a dry film thickness of 4 mils.

D. Broadcast Coat:
1. Apply as a double broadcast system as specified by the Architect.
2. Broadcast coat shall be comprised of two components, a resin, and hardener as supplied by the Manufacturer and mixed in the ratio of 2 parts resin to 1 part hardener.
3. Add resin to hardener and thoroughly mixed by suitably approved mechanical means.
4. Apply over horizontal surfaces using "v" notched squeegee and back rolled at the rate of 90-100 sf/gal.
5. Colored quartz aggregate shall be broadcast to excess into the wet material at the rate of 0.5 lbs/sf.
6. Allow material to fully cure. Vacuum, sweep and/or blow to remove all loose aggregate.
7. Apply a second coat of resin with a coverage rate of 90 sf/gal (Q28) or 50 sf/gal (Q11) and broadcast aggregate to excess at the rate of 0.5 lbs/sf.
8. Allow material to fully cure. Vacuum, sweep and/or blow to remove all loose aggregate.

E. Grout Coat:
1. Grout coat comprises liquid components, combined at a ratio of 2 parts resin to 1 part
2. Apply squeegee coat with a coverage rate of 90 sf/gal (Q28) or 50 sf/gal (Q11) using a hardener by volume and shall be thoroughly blended by mechanical means such as a high speed paddle mixer.
3. Back and cross roll grout coat to provide a uniform texture and finish.

F. Where Architect selects an orange-peel texture, sand screen floor and apply a second grout coat of epoxy. The epoxy shall be applied by squeegee and back-roll with a coverage rate of 200 sf/gal (Q28) or 70 sf/gal (Q11).

G. Topcoat:
1. The topcoat of Armor Top shall be roller applied at the rate of 500 sf/gal to yield a dry film thickness of 3 mils.
2. The topcoat shall be comprised of a liquid resin, hardener and grit that is mixed per the manufacturer's instructions.
3. The finish floor will have a nominal thickness of 1/8 inch.

3.5 FIELD QUALITY CONTROL

A. Applicator Testing and Inspecting: Provide the following:Temperature: Air, substrate temperatures, relative humidity, and, dew point.
2. Coverage rates: Monitor quantity of material used on area covered.

B. Tolerances: Comply with dimensional and location tolerances specified in applicable sections, and as follows:
1. Horizontal Lines and Levels: level by more than 1/8 inch in 10 feet (6 mm in 3 m), or 1/4 inch (12 mm) maximum.

3.6 ADJUSTING / CLEANING / PROTECTION

A. Comply with Division 01 and the following:
1. Cure flooring material in compliance with manufacturer's directions, taking care to prevent their contamination during stages of application and prior to completion of the curing process.
2. Remove masking. Perform detail cleaning at installation completion leaving clean, smooth, unblemished surface

END OF SECTION

SECTION 09 76 50 - FIBER GLASS REINFORCED PLASTIC PANELS (FRP)

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: All of the Contract Documents, and Division 1 General Requirements apply to the work of this Section.

B. Section includes, without limitation, providing:
1. Fiberglass reinforced plastic sanitary wall panels.

C. Extent includes, without limitation:
1. As shown, if not, janitor closet panels.

1.2 REFERENCED CODES AND STANDARDS

A. All references to codes, specifications and standards referred to herein shall become a part of this section as though written out, and shall mean, and is intended to be the latest edition, amendment, and/or revision of such reference unless otherwise specified.
ASTM - American Society for Testing and Materials.
USDA - United States Department of Agriculture.

1.3 SUBMITTALS

A. Samples: Provide two 12" x 12" samples each board and component specified.

B. Manufacturer's Literature: Submit manufacturer's literature for all products furnished to include product characteristics, limitations.

C. Shop Drawings: Provide shop drawings to indicate panel dimensions coordinated with spaces, applications, wall dimensions and other associated Work. Include details of mechanically and adhered trim accessories.

D. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

E. Sustainable Design Submittals shall include:
1. Verify adhesives have a VOC content of 50 g/L or less.
2. Product Data: For adhesives, indicating VOC content.
3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
4. Verify sealant has a VOC content of 250 g/L or less.
5. Product Data: For sealants, indicating VOC content.
6. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

1.4 QUALITY ASSURANCE

A. Use only products having USDA approval of the appropriate resistive characteristics.

B. Provide products cceptable to authorities having jurisdiction and FM Approvals when required for insurance purposes.

1.5 DELIVERY, STORAGE AND HANDLING

A. Comply with Division 1.

PART 2 - PRODUCTS

2.1 FRP SANITARY WALL PANELS

A. Acceptable manufacturers and products: Provide one of the following, subject to compliance with specifications:

1. "Pyro-Panel" Sequentia Series"; Crane Composites; www.cranecomposites.com/.
2. "Custom FRP, Fire Rated"; Kal-Lite Co.; www.kal-lite.com/.
3. "Standard FRP" ; Marlite; www.marlite.com/.
4. Approved equal.

B. Panels where Class A not required: Fiberglass reinforced plastic sanitary wall panels shall be non-combustible, UL listed Class C fire rated, and USDA approved and have the following characteristics:
1. Panel thickness: 0.09 inch [3/32 inch] thick or more.
2. Labels: As required to clearly identify proper fire rating.
3. Texture: As selected by architect including smooth and pebbled.
4. Color: White unless otherwise selected. At their option, architect may select colors from full range.

C. Panels where Class A required: Fiberglass reinforced plastic sanitary wall panels shall be non-combustible, UL listed Class A/1 fire rated, flame spread 25, smoke developed 200 and USDA approved and have the following characteristics:
1. Panel thickness: 0.09 inch thick or more.
2. Labels: As required to clearly identify proper fire rating.
3. Texture: As selected by architect including smooth and pebbled.
4. Color: White unless otherwise selected. At their option, architect may select colors from full range.

D. Adhesives: Multi-purpose construction adhesive of type recommended by manufacturer for the application.
1. VOC requirements: Comply with Division 01 and as follows:
   a. Contact adhesives: 80 g/L.
   b. Special purpose contact adhesives: 250 g/L.

E. Sealant: Water-resistant, Mildew-resistant, single-component, neutral-curing silicone or Mildew-resistant, single-component, neutral-curing or acid-curing silicone Latex sealant recommended by plastic paneling manufacturer and complying with requirements in Division 07 "Joint Sealants."

2.2 ACCESSORY MATERIALS

A. Provide accessories required to complete installation including moldings, trim, and clips. Use fasteners, rivets and the like of type recommended or when available, provided by the manufacturer, and as follows:
1. Exposed trim: Extruded PVC.
2. Exposed colors: Match panels.
3. Fasteners: Stainless steel, type required by application.

PART 3 - EXECUTION

3.1 EXAMINATION OF SURFACES & PREPARATION

A. Examine surfaces and do not commence work until substrate is proper condition to receive work of this section.

B. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.

C. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

D. Lay out paneling before installing. Locate panel joints directly behind and centered on divider panels when spacing is 48 inches or less. At wider divider panel spacing and at walls without same, locate as approved or directed by Architect.

3.2 WORKMANSHIP

A. Install panels, trim, moldings and accessories plumb, plane and true. Follow manufacturer's installation recommendations and guidelines. Comply with USDA and manufacturer installation requirements. Layout work so as to minimize joints, irregular panels and excessive use of trim pieces. Comply with the following:
1. Use full spread of adhesive.

2. Use both adhesive and fasteners. Space fasteners 8 inches on center or per manufacturer's instructions, whichever is less.
3. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.
4. Coordinate installation with adjacent units or assemblies and provide a watertight seal.
5. Maintain uniform space between panels and wall fixtures. Fill space with sealant.
6. 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.

B. Remove defective, stained, damaged or unsightly work and reinstall new products.

3.3 CLEAN-UP, CLEANING AND PROTECTION

A. During the process of the work, premises shall be kept reasonably free of all debris, cuttings and waste materials resulting from the work under this section. Upon completion and before final acceptance of the work, all debris, rubbish, excess materials, tools and equipment shall be removed from the site.

B. Remove any masking materials after installation. Clean any stains on materials which would be exposed in the completed work.

C. Protect completed membrane waterproofing from subsequent construction activities as recommended by manufacturer.

END OF SECTION

SECTION 09 81 10 - ACOUSTICAL INSULATION, SEALANTS & ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Noise separation and sound isolation assemblies using acoustical insulation.
2. Sound-rated-wall gap and penetration sealing.
3. Conventional sound isolation components.

C. Related sections include, without limitation:
1. Division 09 - Framing and gypsum panel board assemblies.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.

C. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide acoustical products that effectively reduce airborne sound transmission through perimeter joints and assemblies in building construction, as demonstrated by testing representative assemblies according to ASTM E 90. Acoustical components shall maintain required or indicated STC ratings at sound rated partitions.
1. Field testing: When and if performed, testing shall be based upon field test FSTC values, not laboratory STC test values. Where an 55 STC rating is indicated, an FSTC rating of 55 is acceptable.

2.2 MANUFACTURERS

A. Acoustic Insulation: Subject to compliance with specifications, provide products from the following:
1. Rockwool International, “Roxul” ; www.rockwool.com/.
2. Owens Corning “Thermafiber”; www.thermafiber.com/.
3. Knauf Insulation; http://www.knaufinsulation.com/.
4. Approved equal.

B. Acoustic sealants: Subject to compliance with specifications, provide products from indicated manufacturers.

C. Accessory and related components: As specified below.

2.3 MATERIALS & COMPONENTS

A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard non-sag, non-hardening, paintable, non-staining latex acoustical sealant complying with ASTM C834 and C919.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. GE Construction Sealants; Momentive Performance Materials Inc.

b. Hilti, Inc.
c. Pecora Corporation.
d. Tremco Incorporated.
e. United States Gypsum Company.

2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.
3. Acoustical sealants in fire rated or smoke rated assemblies: Refer to Division 07, do not use conventional acoustic sealants in fire rated assemblies.

B. Sound isolation and vibration control and gypsum board assemblies:
1. Sound attenuation blankets and batts [SAFB]: 4.0 lbs per cubic foot Thermafiber, Roxul Safe-N-Sound, or approved equal.
2. Stud wall isolation at walls run to underside of structure above: Kinetics Noise Control Wallmat with KAI-S neoprene anchors.
3. Resilient channels: Use types shown, if any, as follows:
a. Walls: Clark-Dietrich RC Deluxe Resilient Channel [RCSD], ½ inch, single leg, 0.022 inch thick minimum; for walls using furring channels and having sound rated assemblies, open leg installed facing up at walls.
b. Ceilings: Clark-Dietrich RC-2 Pro Resilient Channel, ½ inch, double leg, 0.0179 inch [25 gage] thick minimum; for ceilings using furring channels and having sound rated assemblies.
c. Where shown, add additional resilient isolation to channels using the following or approved equal
1) Keene RC Assurance.
2) PAC-International RC-1 Boost.
4. Stud wall isolation at walls run to underside of structure above: Kinetics Noise Control Wallmat with KAI-S neoprene anchors, spaced 48 inches on center unless otherwise shown.
5. Sound isolation hangers: WHR by Mason Industries at ceilings where indicated. Size per imposed load.
6. Sound isolation clips: Provide clips indicated, if not, use one of the following as approved by the Architect:
a. Iso-Max Clips for 7/8 inch metal hat channels by Kinetics Noise Control.
7. Isolated suspended ceiling grid resilient hangers: As shown, if not, Kinetics Noise IsoGrid.
8. Sound isolation at electrical outlets:
a. If shown, use Hilti Firestop putty “clay packs”, per Hilti rated assemblies.
9. Sound isolation at demising heads of demising walls:
a. Hilti Fire stop putty, treated per Hilti sound tested assemblies.
10. Acoustic hangers: WHR by Mason Industries

PART 3 EXECUTION

3.1 INSTALLATION

A. Take field measurements prior to fabrication, where possible. Form to required shapes and sizes with true, straight edges, lines and angles.

B. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with work of other sections.

C. Extend insulation on either side of acoustical rated partitions which do not go to underside of structural deck or surfaces above. Extend as follows:
1. As shown, but at least 24 inches on either side, if not shown or if less shown.

D. Provide acoustical sealant at both faces at top and bottom runner tracks, wall perimeters, openings, expansion and control joints.

E. Ceilings with sound attenuation above ceilings: Extend over entire area of ceiling.

F. Restore damaged finishes and protect work.

END OF SECTION

SECTION 09 84 10.3 – FELT SOUND ABSORPTIVE PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: All Contract Documents and provisions, including Drawings, and Division 01 apply to this Section.

B. Section includes, without limitation, providing:
1. Sound absorptive panels, dimensional felted fabric type.
2. Fabrication.
3. Installation.

C. Extent: As shown.

1.2 SUBMITTALS

A. In accordance with provisions of Division 01 covering submission of samples, product literature and shop drawings, submit the following:

B. Product Data: For each type of panel, edge, core material and mounting indicated.

C. Shop Drawings: For acoustical wall panels. Include mounting devices and details; details at head, jamb and sill conditions and connections at all abutting surfaces and intersections. Include elevations and pattern matching. Shop drawings shall be based on and include field measurements.

D. Samples: For initial selection, submit each type of material available from full manufacture's range. For verification submit actual products to be used in the work from initial selections.:
1. Panel edge: 12 inch long sample showing profile, corner and finish.
2. Core material: 12 inch square sample showing corner.
3. Mounting device[s]: Full size sample.
4. Sample panel: 18 inch square panel max. showing joints and mounting methods.

E. Maintenance Information: Where applicable, submit two copies of maintenance and service information for incorporation into Project Maintenance Manual specified in Division 1 - General Requirements.

F. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 PRODUCT DELIVERY AND STORAGE

A. Comply with Division 1.

1.4 QUALITY ASSURANCE

A. Fabricator qualifications: Fabricator / supplier with not less than 3 years experience.

B. Fire Test Response characteristics: Provide acoustical panels having surface burning test results determined per ASTM E 84 by UL or another testing laboratory acceptable to authorities having jurisdiction as follows:
1. Class: A or 1.
2. Flame spread index: 25 or less.
3. Smoke developed index: 450 or less.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specifications, provide products from:
1. MCD Wallcoverings; www.mdcwall.com/.
2. MPC Silentwall.
3. ATS Acoustics
4. CSI Poshfelt.
5. Approved equal.

2.2 FIXED SOUND ABSORPTIVE WALL PANELS – SYNTHETIC POLYESTER FELT TYPE

A. Wall Panel Models: Provide flat wall or contoured, direct-mount, acoustic fabric panels with fabric with a Class A fire rating per ASTM E84. For 0.50 inch panels.

B. Refer to finish legend for product selections, but include:
1. Zintra Acoustic Panel.
2. Finish fabric thickness: As shown, if not, 0.50 inch.
3. Acoustic Rating: NRC – based upon indicated panel.
4. Subtrate panel thickness: As shown, if not, integral, part of panel.
5. Basis of Design: 100% Wool Design Felt.
6. Substrate: As shown, if not, filzfelt Akustika.
7. Colors: As shown, if not, from full range.

C. Panel Configurations:
1. Edge Detail: As shown, factory cut to shapes; field modification only if permitted by Architect.
2. Dimensions: As shown.
3. Thickness: As shown.
4. Material: 100% Polyester
5. Acoustic Rating 0.45-0.90 NRC
6. Panel Size / Thickness 4’ x 9’ x ½” / 1220mm x 2745mm x 12mm
7. Surface Finish: Matte
8. Weight: 0.5 lb / ft² / 2.4 kg / m²
9. Colors: As selected by Architect from 16 standard colors
10. Application: Indoor areas only
11. Colorfastness to Light: Per AATCC 16.3 option 3 - color change at 20 AFU equal or better than 4.5.

D. Acoustical performance: NRC number depends upon selected product, range is 0.45 to 0.90.

E. Mounting System & Devices: As recommended for application, and as detailed on drawings.
1. Installation: Mechanical or adhesive, using silicon based construction adhesive.
2. Mechanical attachment: As shown to include screws, Z-clips, stand-offs, aluminum trim or millwork integration and mounting.
3. Modification of panels: Utility knife or CNC with oscillating blade.

PART 3 - EXECUTION

3.1 INSPECTION

A. Inspect areas and surfaces indicated to receive specified items. Assure that all necessary blocking and supports are installed to provide adequate anchorage. Do not begin installation if conditions exist which would prevent satisfactory installation. Inform Architect of any deficiencies or installation problems.

3.2 INSTALLATION

A. Install work plumb, level, square and securely fastened to backings and supports with recommended fasteners. Framing of recessed items shall be coordinated with drywall subcontractor. Comply with the following:

1. Protect items from scratches and mars. Touch up minor scratches.
2. Adjust to be true and level and tight to wall surfaces. Scribe wooden components to surfaces and edges.
3. Tolerances: Acoustical panels shall be plumb, plane, level and butted together within 1/16 inch or less of tolerance.

3.3 CLEANING / PROTECTION

A. Comply with:
1. As work progresses, remove all rubbish and debris resulting from work of this Section and leave work areas neat and clean.
2. Clean work of this section before presenting work for acceptance.
3. Provide protection until acceptance at Substantial Completion.
4. Restore or replace construction or furnishings damaged and cannot be acceptably cleaned or repaired.

END OF SECTION

SECTION 09 91 12 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Related documents: Drawings and general provisions of the Contract, and Division 01 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing for exterior substrates:
1. Surface preparation.
2. Application of prime and finish paint systems.

C. Extent: Priming and finishing, without limitation include:
1. Touch up of shop coats provided under other Sections unless specifically included in that Section.
2. Finish painting of exposed piping, conduit, exposed raceways, metal hardware, exposed equipment including rooftop equipment supplied under mechanical and electrical trades, when such items have not been factory pre-painted.
3. Touch up of factory finished items where permitted.

D. Painting not included:
1. Pre-finished items, only when such items are chrome plated, stainless steel, or a finish which has been specifically called for herein.
2. Finish metal surfaces such as chrome, bronze, and stainless steel.
3. Do not paint: Telephone and data cabling. [Note painting these products voids warrantees and interferes with cable functioning.

E. Related Requirements:
1. Section 05 12 00 - Structural steel shop priming.
2. Section 06 06 15 - Interior stains & transparent finishes
3. Section 07 46 10 - Fiber cement siding: Shop finishing.
4. Section 09 91 22 - Interior Painting.

1.2 DEFINITIONS

A. Gloss Level: According to ASTM D 523, as follows:
1. Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees.
2. Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees.
3. Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees.
4. Level 5: 35 to 70 units at 60 degrees.
5. Level 6: 70 to 85 units at 60 degrees.
6. Level 7: More than 85 units at 60 degrees.

1.3 ACTION SUBMITTALS

A. Product Data: Literature for each type of product, including:
1. Preparation requirements.
2. Application instructions.
3. Manufacturer's specifications, with paint label analysis.

B. Color charts/packs: 2 copies of full range of colors with each type of coating submitted. Use compact pack of color chips when available

C. Samples for Initial Selection: For each type of topcoat product.

D. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

5. Name sample and give sheen.
6. Give date when samples where created.

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. Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
3. VOC content.

F. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.4 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.

1.5 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. (9 sq. m).
b. Other Items: Architect will designate items or areas required.
2. Final approval of color selections will be based on mockups.
3. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. 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 (7 deg C).
1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Benjamin Moore [MOR]
2. Sherwin Williams Co. [S-W] [includes Pratt & Lambert)
3. Pittsburgh Paints PPG] (includes Porter.)
4. Tnemec Company, Inc. [TNE]

5. DuPont Nemours Co. [DuP]
6. Approved equal.

2.2 PAINT, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. 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.

C. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.

D. Colors: Provide colors indicated or scheduled, if not, as follows:
1. As selected by Architect from manufacturer's full range
2. Match Architect's samples.
3. Percent of surface area may be painted with deep tones: **20**%

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 paints 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.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
1. Concrete: 12 percent.
2. Masonry (Clay and CMU): 12 percent.
3. Wood: 15 percent.
4. Portland Cement Plaster: 12 percent.
5. Gypsum Board: 12 percent.

C. Portland Cement Plaster Substrates: Verify that plaster is fully cured.

D. Exterior Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

E. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

F. 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 Manual* applicable to substrates and paint systems indicated. For renovation projects comply with *MP Maintenance Repainting Manual*.

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.

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 and masonry surfaces scheduled for painting: Power washed in accordance with SSPCSP12 (LP WC) WJ-4 Condition and as follows:
1. Pressure: 5,000 psi
2. Washing system: Suitable solution, with environmentally approved cleaning agent.
3. Tip: Oscillating tip
4. Purpose: To remove all surface contamination.
5. Rinse: Clean water rinse to remove cleaning residue from washed surfaces.
6. Drying: Allow surfaces to dry completely.
7. Testing: Perform moisture tests before proceeding to ensure dryness criteria met.
8. Where architect permits other concrete and masonry preparation, comply with the follow paragraphs.

E. 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.

F. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

G. 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."

H. 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.

I. Existing Steel Field Finishes Substrates with topcoats: For existing painted steel surfaces to be repainted, remove paint to bare metal using mechanical and chemical means to achieve results equal to:
1. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
2. Prime bare metal immediately.

J. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

K. Aluminum Substrates: Remove loose surface oxidation.

L. Wood Substrates:
1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for exterior use in paint system indicated.
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.

5. To prevent rust showing from nail heads, nails shall be counter-sunk, except at siding. Nail holes and other openings should then be spot-primed with primer before puttying or caulking is done. After putty is set, prime complete surface.

M. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

N. Existing Concrete & Masonry: Prepare and correct minor defects, cracks, ridges, holes, and the like under the work of this section. Make minor repairs where required to produce a smooth, flat even surface.

O. Existing Paint: Prepare and correct minor defects, cracks, ridges, holes, and the like under the work of this section. Make minor repairs where required to produce a smooth, flat even surface. Before paint application, wash surfaces with TSP [tri-sodium phosphate] and allow to dry. Remove dust or other defects prior to paint application. Feather edges and prime areas as required, including multiple times, to ensure no defects, edges, ridges or removed paint areas are evident in the final application.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."
1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
4. Paint entire exposed surface of window frames and sashes.
5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. 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 to view:
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.

3.4 BACK PRIMING

A. Unless specifically required to by provided by another section, prime all 6 of exterior wood before erection. Seal the backs of panels that might cup due to being finished only on one face.

B. At the contractor’s option, but strongly recommended by the Architect, perform as much backpriming as possible in the shop or manufacturing facility.

3.5 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.

3.6 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.

3.7 EXTERIOR PAINTING SCHEDULE – NEW CONSTRUCTION / METAL

A. All Ferrous Metal Surfaces; Galvanized and Non-Galvanized (Unprimed):
Coat 1: Tnemec "Hydro-Zinc" Series 94H20 (min. 2.5 mils DFT).
Coat 2: Tnemec "Typoxy" Series 27WB (min. 3.0 mils DFT).
Coat 3: Tnemec "UVX" Series 740/750 (min. 3.0 mils DFT).

B. All Ferrous Metal Surfaces (Shop Primed):
Coat 1: Tnemec "Typoxy" Series 27WB (min. 3.0 mils DFT).
Coat 2: Tnemec "UVX" Series 740 /750 (min. 3.0 mils DFT).

C. All Galvanized Metals Surfaces: Unprimed.
Zinc Touch-Up: Tnemec "Hydro-Zinc" Series 94H20 (min. 2.5 mils DFT) after SSPC-SP11 Field Prep
Coat 2: Tnemec "Typoxy" Series 27WB (min. 3.0 mils DFT).
Coat 3: Tnemec "UVX" Series 740/750 (min. 3.0 mils DFT).

3.8 EXTERIOR PAINTING SCHEDULE – NEW CONSTRUCTION / MASONRY & CONCRETE

A. Ground Face CMU Surfaces to Seal (RTV Silicone rubber repellent/anti-graffitti):
Coat 1: Tnemec/Chemprobe "Dur-A-Pel GS" Series V626 (65-85 sf/gal).
Coat 2: Tnemec/Chemprobe "Dur-A-Pel GS" Series V626 (65-85 sf/gal).

B. Concrete and Masonry Unit Surfaces to Paint (Smooth):
Coat 1: Tnemec "Tneme-Crete" Series 52 Flat (min. 8-10 mils DFT).
Coat 2: Tnemec "Tneme-Crete" Series 52 Flat (min. 8-10 mils DFT).

C. Concrete and Masonry for Elastomeric Finish:
Coat 1: Block Filler: SW Loxon Masonry Primer.
Coat 2: SW A5-600 100% Acrylic SherLastic Elastomeric Masonry Coating.
Coat 3: SW A5-600 100% Acrylic SherLastic Elastomeric Masonry Coating.

3.9 EXTERIOR PAINTING SCHEDULE – NEW CONSTRUCTION / PVC TRIM & SIDING

A. PVC trim: Modified latex – sheen as selected by Architect:
Coat 1: S-W PrepRite ProBlock Latex Primer/Sealer.
Coat 2: S-W A-100 Exterior Latex (1.2 to 1.5 mils DFT depending upon sheen).
Coat 3: S-W A-100 Exterior Latex (1.2 to 1.5 mils DFT depending upon sheen).
Note: Verify proposed colors have a light reflectance value of 55 or greater.

3.10 EXTERIOR PAINTING SCHEDULE – NEW CONSTRUCTION / OTHER SURFACES

A. Exterior soffits to paint: Modified latex - low lustre:
Coat 1: MOR Morcraft Latex Enamel Undercoater #253 (1.2 mils DFT).
Coat 2: MOR Morgard Latex Low Lustre #103 (1.1 mils DFT).
Coat 3: MOR Morgard Latex Low Lustre #103 (1.1 mils DFT).

END OF SECTION

SECTION 09 91 22 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Related documents: Drawings and general provisions of the Contract, and Division 01 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing for interior substrates:
1. Surface preparation.
2. Application of prime and finish paint systems.

C. Extent: Priming and finishing, without limitation include:
1. Touch up of shop coats provided under other Sections unless specifically included in that Section.
2. Finish painting of exposed piping, conduit, electrical panels, exposed raceways, metal hardware, radiator covers, hangers, exposed ductwork and equipment supplied under mechanical and electrical trades, when such items have not been factory pre-painted.
3. Touch up of factory finished items where permitted.
4. Painting plywood backboards for electrical and telephone equipment.

D. Painting not included:
1. Pre-finished items, only when such items are chrome plated, stainless steel, acoustical tile, or a finish which has been specifically called for herein.
2. Concealed surfaces. "Concealed" here means the insides of shafts, crawl spaces, furred areas, utility tunnels, above hung ceilings and the utilities running in them unless specifically required to be painted.
3. Finish metal surfaces such as chrome, bronze, and stainless steel.
4. Utility piping in Mechanical Rooms.

E. Related Requirements:
1. Section 05 12 00 - Structural steel shop priming.
2. Section 09 91 12 - Exterior Painting.
3. Section 09 93 15 - Interior stains & transparent finishes
4. Section 09 96 00 - High-Performance Coatings.

1.2 DEFINITIONS

A. Gloss Level: According to ASTM D 523, as follows:
1. Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees.
2. Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees.
3. Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees.
4. Level 5: 35 to 70 units at 60 degrees.
5. Level 6: 70 to 85 units at 60 degrees.
6. Level 7: More than 85 units at 60 degrees.

1.3 ACTION SUBMITTALS

A. Product Data: Literature for each type of product, including:
1. Preparation requirements.
2. Application instructions.
3. Manufacturer's specifications, with paint label analysis.

B. Color charts/packs: 2 copies of full range of colors with each type of coating submitted. Use compact pack of color chips when available

C. Samples for Initial Selection: For each type of topcoat product.

D. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
1. Submit Samples on rigid backing, 8 inches (200 mm) square.
2. Step coats on Samples to show each coat required for system.

3. Label each coat of each Sample.
4. 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. Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
3. VOC content.

F. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.4 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: 5 percent, but not less than 1 gal. of each material and color applied.

1.5 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. (9 sq. m).
b. Other Items: Architect will designate items or areas required.
2. Final approval of color selections will be based on mockups.
3. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. 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 (7 deg C).
1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Benjamin Moore [MOR]
2. Sherwin Williams Co. [S-W] [includes Pratt & Lambert)
3. Duron, Inc. [DUR]

4. Pittsburgh Paints PPG] (includes Porter.)
5. Tnemec Company, Inc. [TNE]
6. DuPont Nemours Co. [DuP]
7. Approved equal.

2.2 PAINT, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. 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.

C. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.

D. Colors: Provide colors indicated or scheduled, if not, as follows:
1. As selected by Architect from manufacturer's full range
2. Match Architect's samples.
3. Percent of surface area may be painted with deep tones: **20**%

E. VOC Content: Products shall 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. Dry-Fog Coatings: 400 g/L.
4. Primers, Sealers, and Undercoaters: 200 g/L.
5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Floor Coatings: 100 g/L.
9. Shellacs, Clear: 730 g/L.
10. Shellacs, Pigmented: 550 g/L.

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 paints 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.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   1. Concrete: 12 percent.
   2. Masonry (Clay and CMU): 12 percent.
   3. Wood: 15 percent.
   4. Portland Cement Plaster: 12 percent.
   5. Gypsum Board: 12 percent.

C. Portland Cement Plaster Substrates: Verify that plaster is fully cured.

D. Exterior Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

E. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

F. 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 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.

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 and masonry surfaces scheduled for painting: Power washed in accordance with SSPCSP12 (LP WC) WJ-4 Condition and as follows:
   1. Pressure: 5,000 psi
   2. Washing system: Suitable solution, with environmentally approved cleaning agent.
   3. Tip: Oscillating tip
   4. Purpose: To remove all surface contamination.
   5. Rinse: Clean water rinse to remove cleaning residue from washed surfaces.
   6. Drying: Allow surfaces to dry completely.
   7. Testing: Perform moisture tests before proceeding to ensure dryness criteria met.
   8. Where architect permits other concrete and masonry preparation, comply with the follow paragraphs.

E. 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.

F. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

G. 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."

H. 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.

I. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

J. Aluminum Substrates: Remove loose surface oxidation.

K. Wood Substrates:
1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for exterior use in paint system indicated.
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.
5. To prevent rust showing from nail heads, nails shall be counter-sunk, except at siding. Nail holes and other openings should then be spot-primed with primer before puttying or caulking is done. After putty is set, prime complete surface.

L. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

M. Plastic Trim Fabrication 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 recommendations in "MPI Manual."
1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
4. Paint entire exposed surface of window frames and sashes.
5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. 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, lacking factory finishes.
   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 BACK PRIMING

A. Unless specifically required to by provided by another section, prime all 6 of exterior wood before erection. Seal the backs of panels that might cup due to being finished only on one face.

B. At the contractor's option, but strongly recommended by the Architect, perform as much backpriming as possible in the shop or manufacturing facility.

3.5 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.

3.6 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.

3.7 SHEENS

A. Paint sheens given below are provisional. Obtain written approval from Architect for each surface sheen required.

3.8 INTERIOR PAINTING SCHEDULE – NEW CONSTRUCTION / METAL

A. <u>All Ferrous Metal Surfaces, Galvanized and Non-Galvanized (Unprimed):</u>
Coat 1: Tnemec "Tneme-Zinc" Series 90-97 (min. 3.0 mils DFT).
Coat 2: Tnemec "Enduratone" Series 23 (min. 2.0 mils DFT).
Coat 3: Tnemec "Enduratone" Series 23 (min. 2.0 mils DFT).

B. <u>Hollow Metal Doors, Latex waterbased system x semi-gloss:</u>
Coat 1: S-W Pro Industrial Pro-Cryl® Primer, B66-310 Series (2-4 mils dry)
Coat 2: S-W ProMar® 200 Latex Semi-Gloss, B31W12200 Series
Coat 3: S-W ProMar® 200 Latex Semi-Gloss, B31W12200 Series

C. <u>Hollow Metal Doors, Epoxy waterbased system x semi-gloss:</u>
Coat 1: S-W Pro Industrial Pro-Cryl® Primer, B66-310 Series (2-4 mils dry)
Coat 2: S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy Semi-Gloss, K46- Series 1.5 DFT.

Coat 3: S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy Semi-Gloss, K46- Series 1.5 DFT.

3.9 INTERIOR PAINTING SCHEDULE – NEW CONSTRUCTION / MASONRY & CONCRETE

A. Exposed concrete and masonry unit surfaces to paint: Latex system
Coat 1: S-W PrepRite Blockfiller. [a low-odor product]
Coat 2: S-W "ProMar 200" Zero VOC Latex Primer (min. 1.2 mils DFT).
Coat 3: S-W "ProMar 200" Zero VOC Latex Eg-Shel Finish (min. 1.3 mils DFT).

B. Exposed concrete and masonry unit surfaces to waterproof paint: Styrene acrylic system
Coat 0: Manufacturer recommendation preparation.
Coat 1: Behr “DryPlus” a flat finish with 12 psi hydrostatic pressure resistance.
Coat 2: Behr “DryPlus” a flat finish with 12 psi hydrostatic pressure resistance.
Coat 3: Behr “DryPlus” touch up coat.

C. CMU Surfaces (Epoxy System):
Coat 1: S-W Block filler.
Coat 2: S-W "ProMar 200" Latex Primer (min. 1.2 mils DFT).
Coat 3: S-W "Tile Clad II" Epoxy, B-62 Series (min. 4 mils DFT).
Coat 4: S-W "Tile Clad II" Epoxy, B-62 Series (min. 4 mils DFT).

D. Concrete floor surfaces to paint: Semi-gloss waterbased catalyzed epoxy :
Coat 1: MOR Insul-X GarageGuard Egg-XXX x 2 components [5 to 6 mils wet film thickness]
24 hour wait before 2nd coat
Coat 2: S MOR Insul-X GarageGuard Egg-XXX x 2 components [5 to 6 WFT] with broad cast anti-slip additive.
Cure 4 to 5 days before any use
Comply with manufacturer substrate, preparation and installation recommendations.

3.10 INTERIOR PAINTING SCHEDULE – NEW CONSTRUCTION / DRYWALL

A. Gypsum board ceilings - Latex / flat sheen
Coat 1: S-W ProMar 200 Zero VOC Latex Primer, B28W2600 L.
Coat 2: S-W ProMar 200 Zero VOC Latex Flat, B30-2600 Series, 1.6 mils dry

B. Gypsum board walls - Latex / Egg-shell sheen:
Coat 1: SW " ProMar 200" Zero VOC Vinyl Acrylic Primer Sealer, 1.5 DFT, B28W2600.
Coat 2: SW " ProMar 200 HP" Zero VOC Interior Latex Eggshell, 1.6 DFT, B20-1900 Series.
Coat 3: SW " ProMar 200 HP" Zero VOC Interior Latex Eggshell, 1.6 DFT, B20-1900 Series.

C. Gypsum board walls - Latex / Egg-shell sheen / Dark accent colors:
Coat 1: SW “Premium Wall & Wood Interior Latex Primer”, B28W08111 1.8 DFT. Tint primer to shade gray.
Coat 2: SW “Emerald Interior Latex Satin”, 1.7 DFT, K37 Series
Coat 3: SW “Emerald Interior Latex Satin”, 1.7 DFT, K37 Series

D. Surfaces to receive paint-on vapor barrier, latex:
Surface preparation varies by substrate, at CMU apply SW ProBlock Primer Sealer
Coat 1: SW Moisture Vapor Barrier primer/finish, B72W1 (2 mil DFT)
Coat 2: SW Moisture Vapor Barrier primer/finish, B72W1 (2 mil DFT)

E. Gypsum Drywall Surfaces (Epoxy System/water base - gloss):
Coat 1: S-W PrepRite® 200 Latex Primer, B28W200(4 mils wet, 1.2 mils dry)
Coat 2: S-W Water Based Catalyzed Epoxy, B70/B60V15 Series(2.5-3mils DFT/coat)
Coat 3: S-W Water Based Catalyzed Epoxy, B70/B60V15 Series (2.5-3mils DFT/coat)

3.11 INTERIOR PAINTING SCHEDULE – NEW CONSTRUCTION / WOOD & MILLWORK

A. Utility backerboards and other wood Surfaces, Fire retardant, alkyd/latex, flat:
Coat 1: MOR Alkyd enamel underbody 245 or Fresh Start Alkyd primer 024.
Coat 2: MOR Super Spec HP Vinyl Acrylic Latex fire retardant paint P59-01 x 2.5 DFT
Coat 3: MOR Super Spec HP Vinyl Acrylic Latex fire retardant paint P59-01 x 2.5 DFT

B. Scuff-Resistant Millwork, Trim and Wood Surfaces - Latex / Egg-shell sheen:
Coat 1: Benjamin Moore Ultra Spec 500 Interior Primer N534.
Coat 2: Benjamin Moore Ultra Spec Scuff-X Interior Eggshell Finish 485
Coat 3: Benjamin Moore Ultra Spec Scuff-X Interior Eggshell Finish 485
Note 1: Sheen: Verify required sheen with Architect and obtain specific sheen approval.
Note 2 : Mil thickness: Provide mil thickness application rates recommend by manufacturer.
Note 3: Usage: Provide where indicated, if not shown, at all millwork, trim and painted wood surfaces.

C. Millwork, Trim and Wood Surfaces to Paint – Latex Semi-Gloss:
Coat 1: SW " ProMar 200" Zero VOC Latex Primer Sealer, 1.4 DFT.
Coat 2: SW " ProMar 200" Zero VOC Interior Latex Semi-gloss, 1.6 DFT.
Coat 3: SW " ProMar 200" Zero VOC Interior Latex Semi-gloss, 1.6 DFT, B31 Series.
Note: Verify required sheen with Architect and obtain specific sheen approval.

D. Millwork, Trim and Wood Surfaces, Transparent: Field finished
Prep 1: Sand 120 grit.
Prep 2: Sand 220 grit.
Coat 2: Wood filler to match wood color
Coat 2: Wood sealer to control stain absorption.
Coat 3: Wood stain in uniform color and appearance, type selected from approved samples.
Stain: Equal to S-W Minwax® 250 VOC Stain Series.
Coat 4: Waterbased Clear Acrylic Polyurethane Finish Low Lustre equal to S-W Minwax Waterbased Polyurethane.
Coat 5: Waterbased Clear Acrylic Polyurethane Finish Low Lustre equal to S-W Minwax Waterbased Polyurethane.
(Sand after filler and between coats with 220 grit paper.)
Note: In general transparent coated millwork is to be shop finished. Refer to Division 06.
Note: To avoid uneven sheen, stir to keep flattening agent uniformly mixed in varnish.
Note: Verify required sheen with Architect.

3.12 INTERIOR PAINTING SCHEDULE – NEW CONSTRUCTION / EXPOSED DUCTS, DECKING

A. Exposed Ducts, Joists, Metal Decking, etc. to Paint:
Coat 1: Spray-Applied Tnemec "Unibond" Series 15 Overhead Deck Finish min. 2.5 3.0 mils DFT).

B. Metal Decking exposed from below to paint:
Coat 1: Spray-Applied Tnemec "Unibond" Series 15 Overhead Deck Finish
"White" or “Black” (min. 2.5 - 3.0 mils DFT).

END OF SECTION

SECTION 09 97 10 - CONCRETE FLOOR SEALERS

PART 1 GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Concrete floor sealers on slabs.

C. Extent: Provide sealers and stains where scheduled or shown. Except as otherwise noted floor stains are intended for exposed concrete floors, mechanical and electrical work areas.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.2 ENVIRONMENTAL / SUSTAINABILITY REQUIREMENTS

A. VOC limits in grams per liter. Comply with section 01 81 50 and the following.
1. Interior coatings: [SCAQMD 1168]
   a. Floor coatings: 50
   b. Primers, sealants & undercoaters: 100.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 IMPACT ELASTOMERIC UV RESISTANT INTERIOR EXTERIOR CONCRETE SEALER

A. Manufacturers: Subject to compliance with specifications provide products from:
1. Monopole Inc.; wwwmonopoleinc.com/.
2. Clear-Seal Rainguard.
3. Sherwin Williams
4. Approved equal.

B. Basis of Design: Monopole Monochem Permashield 100.

C. Product characteristics:
1. Type: Water Based Acrylic/Polyurethane.
2. Elastomeric.
3. Useable interior exterior.
4. Anti-microbial.
5. Tire, impact and UV resistant.
6. VOC Level: <40 g/L.
7. Gloss: Low-Gloss, unless otherwise selected by Architect. Availabel semi-gloss and low gloss.
8. Colors: Clear.
9. Coats: Minimum to achieve 2 – 3 dry mils of thickness, (2 coats).
10. Substrate moisture testing required.

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's inspection, preparation, installation requirements for handling, applying and finishing materials and the following:
   1. Substrate Preparation: Remove form release coatings, form oil, curing compound, soil, stains, laitance, efflorescence, dust, joint compound, paint, and all contaminants.
   2. Joint Sealers: Apply joint sealers before applying sealer, hardener, dustproofer.
   3. Application:
      a. Spray apply with low pressure spray.
      b. Saturate the substrate.
      c. Keep 100 percent of substrate wet with sealer, hardener, dustproofer for at least 30 minutes.
      d. Keep material from drying out for at least 30 minutes. Reapply material as needed.
      e. Broom material from low spots to high spots.
      f. Comply with manufacturer's recommended coverage rates.
      g. Remove excess material. White residue indicates excess material.
   4. Drying:
      a. Allow installed work to dry at least 24 hours before any traffic.
      b. Allow installed work to dry at least 7 days before installation of floor finishes, if any scheduled.
   5. Acceptable Appearance: Uniform appearance and sheen without streaks, holidays, puddles, lap marks, white residue, or visible deviations fro uniform appearance.

END OF SECTION

SECTION 10 14 44 – INTERIOR SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section Includes, without limitation, providing:
1. Interior signage.
2. Design/build fabrication.
3. Signage accessories.

C. Intent:
1. Intent of this section is for the Contractor to provide all required space signage, room capacity signage, and accessibility signage per Owner's standard layout and designs and as required by Building and Accessibility codes.
2. The Owners design standards and required layouts are attached to this section.
3. Unless part of the FF&E budget, and where requested or otherwise indicated and if not, signage is shown on drawings, carry an allowance with separate line items to provide design/build:
   a. Code mandated signage.
   b. Occupied and/or office space name identification signage.
   c. Service space signage.
   d. Elevator stair access signage.

D. Extent, without limitation, includes: As shown, if not per intent and as follows:
1. Fire evacuation signs, including at elevator lobbies.
2. Stair and stair door signs.
3. Service & Utility rooms required to be signed by code.
4. Parking clearance signs.
5. Fire extinguisher signs.
6. International handicap access logo and signage
7. Other signage mandated by code
8. Other signage shown on the drawings
9. Toilet room panels signs.
10. Directory locator panel signs.

E. Signage not mandated by code [and/or provided under FF&E Contract].
1. Confer with Architect and Owner about extent of work under this contract, and where requested, provide work and pricing for:
2. Residence unit entry panel signs.
3. Office and administrative area signs.
4. Commons area signage.
5. Site signage, not building-mounted.

F. Related Sections, without limitation, include:
1. Division 26 – Electrical: Power for signs.
2. Section 10 44 20 - Exterior Building Signage.
3. Section 10 44 30 - Field Applied Glass Films.

1.2 SUBMITTALS

A. Comply with Division 01 General Requirements and submit for approval:
1. Product Data: Manufacturer's literature including installation instructions, use restrictions and limitations
2. Shop Drawings – Provide drawings showing all sign characteristics, locations and conditions.

B. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Required ADA-compliant signs shall comply with ADA and have Grade 2 Braille duplicating signage text. Text shall be in raised tactile lettering. Height of characters shall comply with applicable requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with specifications and where no other manufacturers are listed below provide products from one of the following:
1. ACE Sign Systems, Inc.
2. Advance Corporation; Braille-Tac Division.
3. ASI Sign Systems, Inc.
4. Best Sign Systems Inc
5. Approved design/builder fabricator.

2.2 SIGN TYPES

A. Prove interior panel signs with the following features: As shown on drawings, if not, as follows:
1. Type: As shown. Unframed type.
2. Size: As shown. Unless otherwise shown, 6 inches square.
3. Typeface: As selected by Architect and Owner.
4. Braille: in compliance with ADA.
5. Fastening: Concealed foam tape and silicone adhesive, designed for signage, with consistent thickness.
6. Up date panels: Removable name plate units. Provide system to permit Owner to create new name plates of consistent visual character and to match type, background color, lettering color and the like of original installation.

B. Signage criteria for stairs
1. Sign at every floor level landing to identify the stair, floor level, exit level of discharge, and terminus level, and if roof access is available.
2. Approximately 5’ above finish floor
3. Visible with door open and door closed.
4. Direction arrows at every landing where exit level is above landing; visible whether door is open or closed.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the provisions of Division 01 and in particular, Section 01 70 00, and as follows:
1. Install materials and systems in accordance with manufacturer's instructions, limitations and restrictions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.

3.2 INSTALLATION

A. General: Install signs using mounting methods indicated, according to manufacturer's written instructions, and with the code provisions as adopted by authorities having jurisdiction.

B. Install sign units level, plumb and at the height indicated, with sign surfaces free from distortion or other defects in appearance. Repair or replace damaged units as directed by the Architect. Cooperate with other trade contractors for installation of sign units to finish surfaces.

C. Adjust, clean and protect signage until acceptance.

END OF SECTION

SECTION 10 26 05 - WALL & CORNER GUARDS

PART 1 GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Wall corner protection systems.

1.1 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.

C. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.2 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Performance: Fire performance meeting code requirements.

PART 2 PRODUCTS

2.1 MATERIALS

A. Corner Guards:
1. Manufacturers: Arden Architectural Specialties; Balco/Metalines; Construction Specialties; InPro Corporation; IPC Door and Wall Protection Systems; Pawling Corp., Architectural Products Div.; Spectrim Building Products, LLC; Tepromark International; or approved equal.
2. Locations: As shown or scheduled.
3. Type : Stainless steel corner guards, surface mounted, full height, service areas and where shown and as follows:
   a. Flush-mount stainless steel Type 430 or 304 16 gauge, w/ 3.5” wings.
   b. Equal to InPro SS Flush Mount.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install materials in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.

B. Restore damaged finishes. Clean and protect work from damage.

END OF SECTION

SECTION 10 28 10 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Scheduled accessories shown on drawings.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.

C. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
1. A& J Wash room accessories.
2. American Specialties Inc.,
3. Bobrick Washroom Equipment,
4. Bradley Corp.
5. GAMCO Specialites.
6. Rubbermaid.
7. Kohler.

2.2 ACCESSORIES

A. In general, toilet accessories shall be as scheduled on drawings. If not scheduled, provide products given below.

2.3 PUBLIC USE & STAFF TOILET ROOMS

A. Provide the following is not otherwise scheduled:
1. Toilet Tissue (2 Roll) Dispenser: No. B-4388; 1 at each toilet.
2. Combination Towel (Folded) Dispenser/Waste Receptacle, (Recessed): No. B-369; at each bathroom.
3. Liquid-Soap Dispenser, Wall: No. B-4063; 1 at each sink.
4. Liquid-Soap Dispenser, Deck: No. B-822; (1) at each sink where not wall mounted.
5. Grab Bars: No. B-5806.99 x length required; (2) horizontal and 1 vertical at each toilet; or “L” shaped units of lengths that satisfy requirements of Authorities Having Jurisdiction.
6. Swing-up Grab Bars: No. B-4998.99; (1) at each toilet only if required by Authorities Having Jurisdiction, or where indicated on Drawings.
7. Sanitary-Napkin Disposal Unit: No. B-353; (1) at each bathroom where indicated/scheduled.
8. Mirror Unit: B-1658 1830, (Or other approved mirror as indicated).
   a. Size: 18” x 30”; (1) at each lavatory, where indicated.
9. Robe / Leash hook: No. B-6727; (1) at each toilet room door, or if toilet stall compartments are provided on Drawings, (1) at each toilet stall compartment door.

2.4 RECEPTION DESK

A. Robe / Leash hook: No. B-6727; provide where indicated or if not indicated a total of four (4) hooks.

2.5 BATHING/GROOMING AREAS – (WHERE APPLICABLE)

A. Robe / Leash hook: No. B-6727; provide where indicated or if not indicated a total of (1) hook at each station.

2.6 UNDER LAVATORY GUARDS

A. Under lavatory Guard: Lav Guard 2 E-Z series, Trubro Lav Guard, manufactured by IPS Corporation; 1 at each exposed lavatory drain.

2.7 CUSTODIAL ACCESSORIES

A. Mop and Broom Holder: No. B-232 x 24", or 36"; 1 at each janitor closet, as indicated.

2.8 SOAP, TOWEL, TISSUE & NAPKIN PRODUCTS

A. Provide products as selected by Owner from product lines offered by manufacturer or toilet accessory vendor.

B. Provide the following quantities of dispensing products:
   1. Soap(s): Quantities to fill all dispensers with an additional maintenance stock of two, (2) unopened full, (approximately gallon sized), containers of each product.
   2. Towels, Tissues & Napkins: Quantities to fill all dispensers with an additional maintenance stock of two (2) unopened, full cartons or boxes of each product.

2.9 SHOWER DOOR

A. Comply with the following:
   1. Semi-Frameless Stall Showers with Continuous Hinge Swing Doors:
   2. Height: 72 5/8 inches (1845 mm).
   3. Configuration: Semi-Frameless Enclosure with Single door (CD) as manufactured by Cardinal Shower Enclosures.
   4. Aluminum extrusion finish: Satin.
   5. Header Style: No header required for Single Door (CD) enclosure.
   6. Hardware: 8-inch Back-to-Back C-Pull.
   7. Glass Type: Clear, 3/16 inch (4.75 mm) thick, Standard.
   8. Surface Protection System for Glass: Surface Protection per manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections. Remove temporary labels and protective coatings.

B. Restore damaged finishes and test for proper operation. Clean and protect work from damage.

END OF SECTION

SECTION 10 44 00 - FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Fire extinguishers.
2. Cabinets.
3. Accessories.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.

C. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Standards: UL and FM listed products, NFPA 10.

C. Regulations: ADAAG.

PART 2 PRODUCTS

2.1 MATERIALS

A. Fire Extinguishers:
1. Manufacturers: J. L. Industries; Larsen’s Manufacturing; Potter-Roemer; or approved equal.
2. Extinguishers: Filled, charged, pressurized, tagged, dated, and rechargeable. Underwriters Laboratories and FM approved.
3. Type: Multipurpose dry chemical type, UL 4A-80B:C
   a. Verify with Owner and local fire official extinguisher size required. Some facilities may sue UL 3A-40B:C
4. Rating: Verify sizing for project requirements.
5. Public Area Mounting: Cabinet mounted.
6. Service Area Mounting: Metal brackets.

B. Cabinets:
1. Manufacturers: J. L. Industries; Larsen’s Manufacturing; Potter-Roemer; or approved equal.
2. Basis of design: Larsen “Architectural Series”, model number 24096R-FG

C. Cabinet trim style: Rolled edge, semi-recessed cabinet.
1. Projection from wall: nominal 2-1/2 inches.
2. Full glazed design with clear tempered safety glass.
3. Door and trim: Cold-rolled steel with factory applied white thermally fused polyester coating, acceptable to receive a field applied recoating.

4. Handles: Red door handles having raised letters “FIRE”.
5. Lettering: Factory furnished vertical reading, black or red decals, selected by Architect, for field application. Install where required by governing authorities and directed by Architect.
6. Provide matching surface mounted units at masonry wall locations where semi-recessed units can’t provide the required 4-inch recess because of wall thickness.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.

B. Install fire extinguishers in mechanical and service areas with wall-hung brackets at locations and heights indicated and acceptable to authorities having jurisdiction.

C. Install fire extinguishers in cabinets in public areas plumb and level at heights acceptable to authorities having jurisdiction.

D. Restore damaged finishes. Clean and protect work from damage.

END OF SECTION

SECTION 11 31 10 – RESIDENTIAL GRADE KITCHEN APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section Includes, without limitation, providing:
1. Residential kitchen appliances.

1.2 PERFORMANCE REQUIREMENTS

A. Energy Star: All other indications to the contrary, provided only Energy Star rated and compliant units.

B. Accessibility: For appliances in public use or in accessible dwellings: Comply with applicable provisions of ADA and state barrier free accessibility requirements.

C. CFC: Provide refrigerants CFC free and compliant with applicable regulations.

1.3 SUBMITTALS

A. Comply with Division 01 General Requirements and submit for approval:
1. Product Data: For each product, Manufacturer's literature including installation instructions, use restrictions and limitations.
2. Shop drawings:
   a. For all units: Provide unit dimensions and installation clearances required.
   b. For built-in units, provide shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction and templates for work installed by others.
   c. Field Measurements: Take accurate field measurements before installation and indicate same on shop drawings for built in units.
3. Samples: Color and material ranges showing variation of color and finish, if any.
4. Operation and maintenance Data: Provide recommended maintenance procedures, including operating instructions, list of spare parts and maintenance schedule.
5. Warranty: Manufacturer's standard warranty. Include labor and materials to repair or replace defective materials.

B. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.4 QUALITY ASSURANCE

A. Comply with Division 01 requirements and governing codes and regulations.

B. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for 5 years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable manufacturers and fabricators, subject to compliance with requirements, include:
1. GE.
2. Approved equal.

B. Basis of design: GE Profile Series, as scheduled or approved equals..

2.2 APPLIANCES – GENERAL

A. Appliance: Provide scheduled units or approved equals including:

1. Ranges, electric.
2. Range hoods, recirculating type.
3. Refrigerator/freezers.
4. Microwave/convection ovens.
5. Microwave ovens.
6. Garbage disposals.
7. Dishwashers.

2.3 ACCESSORIES / COLOR

A. Whether customarily supplied with the units or not, provide all pigtails, plugs and associated wiring, as well as all lamps, bulbs, and the like.

B. Color: Unless otherwise indicated or selected, units shall be color indicated, if none, stainless steel.

2.4 KITCHEN APPLIANCE SCHEDULE

A. Provide products from a single manufacturer and equal or superior to basis of design and specified performance and as scheduled on drawings, in appliance schedule provided elsewhere but if not, as given below:

B. Refrigerator:
1. Model: GFE24JSKSS
2. Color: Stainless steel.
3. Capacity: 25.6 cu.ft.
4. Type: French door.
5. Energy star: Yes

C. Range: 30 inch model.
1. Model: JD630FSS.
2. Color: Stainless steel.
3. Oven hinge: Bottom hinged.
4. Oven cleaning: Self-clean.
5. Type: Electric, Drop in.
6. Energy star: Yes.

D. Microwave oven:
1. Model: As scheduled.
2. Color: As scheduled.
3. Trim kit: Required, for built in appearance.
4. Energy star: Yes.

E. Microwave / convection oven:
1. Model: As scheduled.
2. Color: As scheduled.
3. Trim kit: Required, for built in appearance.
4. Energy star: Yes.

F. Hood: 30 inch model.
1. Model: JV536HSS
2. Color: Stainless steel.
3. Features: 2 speed fan, built-in light.
4. Type: convertible.
5. Energy star: n/a

G. Dishwasher:
1. Model: GLDT696JSS
2. Color: Stainless steel.
3. Features: 5 cycle, auto detergent, stainless steel interior.
4. Type: Per model indicated.
5. Energy star: Yes

H. Disposer: [if not specified in plumbing]
1. Manufacturer: Insinkerator
2. Capacity: ½ hp or more.
3. Type: continuous feed, remote on-off switch.
4. Switch: Remote, accessible mounting on counter apron.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the provisions of Division 01 and in particular, Section 01 70 00.

3.2 INSTALLATION

A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.

B. Comply with the following:
1. Built-In Equipment: Securely anchor units to supporting cabinetry or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed. Install appliances level and plumb.
2. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate for proper operation of equipment.
3. Utilities: Refer to Drawings for plumbing, venting and electrical requirements. Connect units to service utility terminations provided by the trades.
4. Start up and fully test all appliances. Replace or repair any units not found to operate properly.
5. Level refrigerator so that doors are self-closing when open 45` or less.
6. Leave Owner's Manual for all appliances in cabinet drawer in kitchen.
7. Furnish and install lamps in all appliances which require them.

C. Remove interior packing material from appliances, debris resulting from appliance installation and properly dispose of it. Repair or replace work of other trades soiled or damaged by work of this Section. Clean and protect work from damage.

END OF SECTION

SECTION 11 79 90 – VETERINARY EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes:
1. Coordination with Owner furnished and installed equipment.
2. Verification of extent of Owner Furnished and Contractor installed equipment, before and during bidding process.
3. Verification of extent of Contractor Furnished and Contractor installed equipment, before and during bidding process.

C. Extent:
1. Equipment is shown and scheduled on the drawings.
2. Part of the work of this section is familiarizing the Contractor's obligations for the work before and during bidding to ensure bid prices reflect the required work.
3. The drawing schedule lists both *furnished by* and *installed by* for equipment indicated.

1.2 SUBMITTALS

A. Comply with Division 01 General Requirements and submit for approval:
1. Product Data: Manufacturer's literature including installation instructions, use restrictions and limitations.
2. Shop drawings: Large scale drawings for fabrication, installation and erections including plans, elevations, details, anchorages, connections and accessories along with head, jamb, sill and joining details. Provide templates for work installed by others.
   a. Field Measurements: Take accurate field measurements before fabrication and indicate same on shop drawings.
3. Samples: Submit samples of panel materials, fasteners and misc. accessories.
4. Verification: Submit final samples of selected products. Include samples showing full variation of color and finish expected.
5. Maintenance Data: Provide recommended maintenance procedures.
6. Certification: Certify submitted materials comply with requirements.

B. Mock-Up/Field Samples: Prior to installation, provide mock up of each type of system proposed for use for approval. Accepted mock-ups may be incorporated into the work unless otherwise noted.

C. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. As scheduled.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.

B. Comply with the following:
1. Built-In Equipment: Securely anchor units to supporting cabinetry or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed. Install appliances level and plumb.
2. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate for proper operation of equipment.
3. Utilities: Refer to Drawings for plumbing, venting and electrical requirements. Connect units to service utility terminations provided by the trades.
4. Start up and fully test all components. Replace or repair any units not found to operate properly.
5. Level units so that doors are self-closing when open 45` or less.
6. Leave Owner's Manual for all equipment in place, near units.
7. Furnish and install lamps in all units which require them.

3.2 ADJUSTING AND CLEANING

A. Adjust equipment, components and accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Remove interior packing material from equipment, debris resulting from installation and properly dispose of it. Repair or replace work of other trades soiled or damaged by work of this Section.

D. Clean and polish exposed surfaces according to manufacturer's written recommendations.

E. Protect work from damage until acceptance.

END OF SECTION

SECTION 12 24 11 - MANUAL ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Roller shades.
2. Manual operation.

C. Related Requirements include:
1. Section 06 10 50 - Wood blocking

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.

B. Shop Drawings: Show location and extent of roller shades. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other work, operational clearances, and relationship to adjoining work.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Ceiling suspension system members and attachment to building structure.
2. Ceiling-mounted or penetrating items including light fixtures, air outlets and inlets, speakers, sprinklers, recessed shades, and special moldings at walls, column penetrations, and other junctures of acoustical ceilings with adjoining construction.
3. Shade mounting assembly and attachment.
4. Size and location of access to shade operator, motor, and adjustable components.

D. Samples: For each colored component of each type of shade indicated.
1. Include similar Samples of accessories involving color selection.

E. Window Treatment Schedule: For roller shades. Use same designations indicated on Drawings.

F. Maintenance Data: For roller shades to include in maintenance manuals.

G. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Source Limitations: Obtain roller shades through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide roller shade band materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
1. Flame-Resistance Ratings: Passes NFPA 701.

D. ShadeCloth Anti-Microbial Characteristics: 'No Growth' per ASTM G 21 results for fungi ATCC9642, ATCC 9644, and ATCC9645.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in factory packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same designations indicated on Drawings and in a window treatment schedule.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Designer of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Rollers Shades: Before installation begins, for each size, color, texture, and pattern indicated, full-size units equal 2 percent of amount installed.

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, the following:
1. MechoShade Systems, Inc.
2. Hunter Douglas Nysan Solar Control.
3. Levelor.
4. Draper.
5. Approved equal.

B. Basis of design:
1. Manual shades: MechoShade “Mecho5”

2.2 ROLLER WINDOW SHADES

A. Shade Band Material: PVC-coated fiberglass
1. Pattern: As indicated
2. Style: As indicated
3. Colors: Match Designer's samples.
4. Material Openness Factor: As indicated
5. Material UV Blockage: As indicated, but between 3 to 5%
6. Bottom Hem: Straight.

B. Solar control shade cloth where not indicated on drawings: If not shown, provide the following:
1. Shade Cloth: Where no selections are shown on drawings or in schedules, provide the following:
2. Visually Transparent Roller Shade Band Material: Manufacturer's standard 0.010 diameter (0.254 mm) non-raveling vinyl/polyester yarn, minimum fabric thickness 0.025 inches (0.635 mm).
   a. Basis-of-Design Product: MechoShade Systems, Inc.; "EuroTwill 6000 Series”.
   b. Content: 85 percent vinyl, 15 percent polyester core.
   c. Material Openness Factor: 3 percent.
   d. Bottom Hem: Straight.

C. Rollers: Electrogalvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets; with removable spline fitting integral channel in tube for attaching shade material.
1. Direction of Roll: Regular, from back of roller
2. Mounting Brackets: Galvanized or zinc-plated steel.

D. Fascia: L-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; continuous panel concealing front and bottom of shade roller, brackets, and operating hardware and operators; length as indicated on Drawings removable design for access.

E. Top/Back Cover: L-shaped; material and finish to match fascia; combining with fascia and end caps to form a six-sided headbox enclosure sized to fit shade roller and operating hardware inside.

F. Pocket-Style Headbox: U-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; with a bottom cover consisting of slot opening of minimum dimension to allow lowering and raising of shade and a removable or an openable, continuous metal access panel concealing shade roller, brackets, and operating hardware and operators within.

G. Bottom Bar: Manufacturer standard.

H. Mounting: As indicated on Drawings, mounting permitting easy removal and replacement without damaging roller shade or adjacent surfaces and finishes.
   1. Hold-Down Brackets and Hooks or Pins: Manufacturer's standard for anchoring roller shade bottom in place and keeping shade band material taut.

I. Shade Operation: Manual chain as required operator.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, accurate locations of connections to building systems, and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions, and located so shade band is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller shade surfaces after installation, according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train facility maintenance personnel to adjust, operate, and maintain roller shade assemblies.

END OF SECTION

SECTION 12 36 65 - QUARTZ SURFACE COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section Includes, without limitation, providing:
1. Horizontal quartz surface fabrications.

C. Extent, without limitation, includes:
1. Counter tops.
2. Setting materials and accessories.

D. Related requirements includes, without limitation:
1. Division 06 00 00 - Wood blocking.
2. Division 06 00 00 - Casework & millwork.

1.2 QUALITY ASSURANCE

A. All material provided shall be graded in accordance with the following standards:
1. Marble Institute of America [MIA] Dimension Stone Design Manual VII Version 7

B. Field Dimensions:
1. Verify actual dimensions of areas to receive shop fabricated woodwork by taking field dimensions.
2. Show field dimensions on final shop drawings.
3. Build shop fabricated work to fit field conditions.
4. Provide full size field templates for stone countertops.

C. Comply with the following fire test characteristics surface burning per UL 723 (ASTM E 84:
1. Rating: Class A (Class I).
2. Flame Spread Index: 25 or less.
3. Smoke Developed Index: 450 or less.

D. Allowable tolerances:
1. Variation in component size: ±1/8" (3 mm) over a 10' length.
2. Location of openings: ±1/8" (3 mm) from indicated location.
3. Maximum 1/8" clearance between quartz surfaces and each wall.

1.3 SUBMITTALS

A. Comply with Division 1 General Requirements and submit for approval:
1. Product Data: Manufacturer's literature including installation instructions, use restrictions and limitations.
2. Shop drawings: Large scale drawings for fabrication.. Show:
   a. Edge details.
   b. Furring and blocking.
   c. Holes and cut outs.
   d. Seam locations.
3. Samples: Submit samples of selected products. Include samples showing full variation of color and finish expected. Include:
   a. 6x6 samples of selected color(s).
   b. Sample of seam technique.
4. Maintenance Data: Provide recommended maintenance procedures.

B. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.4 WARRANTY

A. Provide manufacturer's 10-year warranty against defects in materials.
   1. Warranty shall provide material to repair or replace defective materials.

PART 2 - PRODUCTS

2.1 QUARTZ COUNTERTOPS & SURFACES

A. Manufacturers; providing a homogeneous quartz surface material:
   1. Silestone quartz surfaces from Cosentino USA, Inc.
   2. Corian Quartz [formerly Zodiaq®]quartz surfaces from DuPont.
   3. Cambria quartz surfaces from Cambria USA, Inc.
   4. MSI.
   5. Approved equal.

B. Basis of design: As scheduled, if not, MSI Q quartz, price group 1 (lowest), 0.75 inch thick.

C. Provide products meeting the following:
   1. Properties: Per table below.
   2. Thickness: As shown, if not, 20mm [19.05mm is acceptable and equal to .075 inch]
   3. Back splash: At back and sides, 1/4 inch thick x 4 inch high unless otherwise shown.
   4. Grade: Architectural countertop grade and free of cracks, seams, starts or other traits which impair integrity, function or appearance.
   5. Selection: As scheduled, if not schedule full range available.
   6. Edge Profile: As shown, if no shown: Eased, pencil edge.
   7. Faucet holes: Field measure and make template or field drill.
   8. Sinks: If shown, undermount.
   9. Spline and rod material: Stainless steel
   10. Cleats and supports: Reinforce thin edges at cut-outs. Provide hold down cleats, splines and or rods.
   11. Colors: Selected from full range unless identified in Finish Legend.
   12. Usage: Where shown, if not, vanity counters.

2.2 ROUGH HARDWARE

A. Provide all rough hardware required to complete the work using concealed fastenings wherever possible. In general, concealed fastenings shall be bright steel primed USP, or stainless steel. All exposed fastenings in all locations shall be non-ferrous or stainless steel as selected or approved in each case by the Architect.

2.3 ACCESSORY MATERIALS

A. Provide accessories required to complete work as required and which may include:
   1. Adhesives: Non-staining, type recommended by manufacturer including construction adhesive and silicones.
   2. Shims: Non-compressible filler such as epoxy or polyester resin.
   3. Joint filler: Type recommended by supplier and fabricator for application and acceptable to Architect.

2.4 MATERIAL PROPERTIES

A. Provide materials with the following physical characteristics:
   1. Static coefficient of friction: 1.02 dry, 0.51 wet, tested to ASTM C1028.
   2. Water absorption: Maximum 0.03 percent, tested to ASTM C97.
   3. Compressive strength: Minimum 29,000 psi, tested to ASTM C170.
   4. Bond strength: Minimum 210 psi, tested to ASTM C482.
   5. Modulus of rupture: Minimum 6300 psi, tested to ASTM C99.
   6. Flexural strength: Minimum 5800 psi, tested to ASTM C880.
   7. Breaking strength: Minimum 480 lbf, tested to ASTM C648.
   8. Stain resistance: Not affected by 10 percent hydrochloric acid or 10 percent KOH, tested to ASTM C650.
   9. Thermal shock resistance: Pass 5 cycles, tested to ASTM C484.
   10. Abrasive index: 65-Ha = 25, tested to ASTM C241.
   11. Flame spread rating: Class 1, tested to ASTM E84.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the provisions of Section 01 70 00 - including requirements related to:
1. Inspection and examination. Tolerances and measurement.
2. Approvals, inspections and filed quality control.
3. Layout. Cleaning. Protection.

3.2 PREPARATION

A. Deliver inserts and similar anchoring devices to be built into substrates, well in advance of time substrates are to be built.

B. Prior to installation, examine shop fabricated work for completion, and complete work as required. Verify templates against actual field conditions before starting installation.

3.3 FABRICATION

A. Fabricate work in shop from full size templates made in the field.

B. Finished work shall be dressed and polished until free from machine and tool marks, abrasions, grain, or other defects on surfaces exposed to view. Match approved finish texture samples.
1. Rout and finish component edges with clean, sharp returns.
2. Rout cutouts, radii and contours to template.
3. Reinforce as required using non-staining corrosion protected metals.

3.4 INSTALLATION -- GENERAL

A. Comply with MIA standards and the following:
1. Installation: Set work plumb, level, true and straight.
2. Leveling: Shim as required using concealed shims.
3. Fitting: Scribe and cut work to fit adjoining work, and refinish cut surfaces or repair damaged finish at cuts.
4. Attachment: Secure work to anchors or blocking built-in or directly attached to substrates.
5. Form field joints using manufacturer's recommended adhesive, with joint widths no greater than 1/16" in finished work.
6. Adhere back, end and side splashes to countertops using manufacturer's standard color-matched silicone sealant.

3.5 ADJUSTMENT, CLEANING, FINISHING AND PROTECTION

A. Repair damaged and defective work wherever possible to eliminate defects functionally and visually; where not possible to repair properly, replace material. Comply with the following:
1. Clean exposed and semi-exposed surfaces. Touch- up shop-applied finishes to restore damaged or soiled areas. Remove adhesives, sealants and other stains.
2. Repair or replace work other trades damaged or soiled by the work of this Section.

END OF SECTION

SECTION 12 48 13 - ENTRANCE MATS & FRAMES

PART 1 GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section includes, without limitation, providing:
1. Mats.
2. Frame assemblies.
3. Coordination and preparation.
4. Leveling grouts.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
1. Base shop drawings on field measurements

C. Samples: Submit two representative samples of each material specified indicating visual characteristics and finish. Include range samples if variation of finish is anticipated.

D. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including cleaning instructions, list of spare parts and maintenance schedule.

E. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Meet or exceed the following:
7. Flammability in accordance with ASTM E648, Class 1, Critical Radiant Flux, minimum 0.45 watts/m2
8. Rolling load performance: Not less than 500 lb./wheel (load applied to a solid 5” x 2” wide polyurethane wheel, 1000 passes without damage).
9. Slip resistance in accordance with ASTM D-2047-96, Coefficient of Friction, minimum 0.60 **when wet** for accessible routes.
10. ADA compliance: Comply state and local accessibility requirements.

B. Warranty: Provide manufacturer’s 2 year limited warranty covering wear, color retention and integrity of fiber to backing bond.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specifications, provide assemblies from one of the following:
1. Shaw Contract Group.
2. Mats, Inc.

3. Nystrom Building Products.
4. Construction Specialties;
5. Balco/Metalines;
6. Pawling Corp.; or
7. Approved equal.

B. Basis of design: As scheduled. See finish schedules and legends, if not scheduled, base products on:
1. Soft Grid by Mats Inc. an open web link vinyl.

2.2 MAT & FRAME ASSEMBLIES.

A. Provide units matching basis of design and the following:
1. Mounting / Application: Recessed, with frame.
2. Type: Open web vinyl link.
3. Depth: As shown, or required by scheduled product, if not 0.375.
4. Loading: Meet or exceed specified loading performance.
5. Coefficient of friction: As specified or better.
6. Linkage material: Vinyl.
7. Frame material: 0.125 inch thick or heavier, extruded aluminum, ASTM B 221, alloy 6063-T5, clear anodized or painted as selected by Architect; prime coat aluminum connect with concrete. Provide “filler” to meet edges of adjacent finish materials.
8. Color: As scheduled or selected by Architect.

2.3 ACCESSORIES

A. Levelers and fillers: Provide materials by Silpro, Ardex or comparable specialty manufacturers using materials with latex admixtures for flexibility and adhesion of types recommended by manufacturer for the application.

PART 3 EXECUTION

3.1 INSTALLATION

A. Fabricate units in shop to greatest extent possible. Verify sizes by field measurement before fabrication where possible; do not delay job progress.

B. Comply with manufacturer's instructions and recommendations. Install frame with longest available pieces and hairline joints. Shim, anchor and grout in place. Place grids or mats to prevent tripping hazards and interference with door swings. Clean and protect work from damage.

END OF SECTION

SECTION 220000 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
   1. Provide Payment and Performance Bonds for the full value of their Subcontract.
   2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
   1. Comply with the Instructions to Bidders.
   2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
   3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
   4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
      FILED SUBCONTRACTOR'S BID FOR SECTION:
      22 00 00 – COMMON WORK RESULTS FOR PLUMBING

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
   1. All subcontractors to the Filed Subcontractor, whose work is:
      a. Valued at $10,000 or more.
   2. The contract sum for each subcontractor required to be listed.
      a. An affidavit that all subcontractors named on the Filed Subcontractor's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
   3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
   4. Comply with the applicable New York General Laws and the following:
      a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the

Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None.	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. P0.01 – Plumbing Schedules and Details
2. P0.02 – Plumbing Notes
3. P0.03 – SMT Rough-In Details
4. P0.04 – Sanitary Waste and Natural Gas Riser Diagrams
5. P1.01 – Sanitary Plan
6. P2.01 – Water Piping Plan
7. P3.01 – Natural Medical/Gas and Storm Drainage Plan
8. P3.02 – Roof Natural Gas and Storm Drainage Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 22 00 00 – Common Work Results for Plumbing
2. Section 22 05 13 – Common Motor Requirements for Plumbing Equipment
3. Section 22 05 16 – Expansion Fittings and Loops for Plumbing Piping
4. Section 22 05 17 – Sleeves and Sleeve Seals for Plumbing
5. Section 22 05 18 – Escutcheons for Plumbing Piping
6. Section 22 05 19 – Meter and Gauges for Plumbing
7. Section 22 05 23 – General Duty Valves for Plumbing Piping
8. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
9. Section 22 05 48 – Vibration Controls for Plumbing Piping and Equipment
10. Section 22 05 53 – Identification for Plumbing Piping and Equipment
11. Section 22 07 00 – Plumbing Insulation
12. Section 22 08 00 – Commissioning of Plumbing Systems
13. Section 22 10 00 – Plumbing Equipment
14. Section 22 11 18 – Domestic Water Distribution System
15. Section 22 11 19 – Plumbing Specialties
16. Section 22 13 16 – Sanitary Waste and Vent Piping
17. Section 22 13 19 – Sanitary Waste Piping Specialties
18. Section 22 31 00 – Domestic Water Softeners
19. Section 22 34 00 – Domestic Water Heaters
20. Section 22 40 00 – Plumbing Fixtures

B. Alternates: None.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.4 SUMMARY

A. The 00.72.00 Conditions of the Contract and all sections of Division 01, General Requirements shall be part of this section unless otherwise specifically excluded.
B. Examine all conditions as they exist at the project prior to submitting a bid for the work of this SECTION
C. Refer to SECTION 01 23 00 ALTERNATES for working affection this SECTION.
D. This Section includes the following:

1. General Plumbing Requirements specifically applicable to all Division 22 Sections.
2. Some piping material and installation instructions common to most piping systems.
3. Grout.
4. Plumbing Demolition (when indicated on the drawings).
5. Equipment installation requirements common to equipment sections.
6. Concrete bases.
7. Supports and anchorages.

1.5 SCOPE OF WORK

A. The scope of work consists of the installation of all materials to be furnished under Section 23.00.00, and without limiting the generality thereof, consists of furnishing all labor, materials, equipment, plant, transportation, rigging, staging up to 8 feet, appurtenances, and services necessary and/or incidental to properly complete all work as shown on the Plumbing drawings, as described in the Specifications, or as reasonably inferred from either, in the opinion of the Architect

1.6 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact

by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene monomer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.7 REFERENCES AND STANDARDS:

A. The latest editions recognized by the State of NY of the following are hereby included in and made a part of Division 22:

1.	NFPA	National Fire Protection Association
2.	UL	Underwriters' Laboratories, Inc.
3.	NEMA	National Electrical Manufacturer's Association
4.	NEC	National Electric Code
5.	ASME	American Society of Mechanical Engineers
6.	AWS	American Welding Society
7.	ANSI	American National Standards Institute
8.	AGA	American Gas Association
9.	HI	Hydronics Institute
10.	OSHA	Occupational Safety and Health Act
11.	AWWA	American Water Works Association
12.	CISPI	Cast Iron Soil Pipe Institute

1.8 ALTERNATIVES

A. Attention is directed to Section 01.23.00 ALTERNATES for a detailed description of all Alternates.

B. The Plumbing subcontractor shall be responsible for examining the scope of each Alternate and for the Work caused by the Alternates and for including the costs thereof in the appropriate space in paragraph A of the Form for Sub-bid.

1.9 SUBMITTALS

A. Attention is directed to Specification Section 01300 Submittals.

B. Attention is directed to Specification Section 01.25.13 OR Equals

1.10 RECORD DRAWINGS

A. Refer to Specification Section 01.78.39 for the Record Drawing requirements for this section.

B. The marked up As Built Drawings required to be maintained under this section are of Drawings P1.00 – P4.00.

C. Availability of marked up As Built drawings shall be a prerequisite to scheduling final inspection of this contract and said drawings and original contract documents will be used in checking completion of the work..

D. Non-availability of marked up As Built drawings or inaccuracies therein may be grounds for cancellation and postponement of any scheduled final inspection by the Architect until the discrepancy has been corrected.

1.11 QUALITY ASSURANCE AND COORDINATION

A. Electrical Characteristics for Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

B. All work to meet in-force local plumbing code. In the case of discrepancies between the project contract documents and the in-force local code, the most stringent shall govern.

C. As NU FMO plumbing staff shall walk through and inspect all plumbing work prior to walls or ceilings being closed up, deficiencies shall be noted and given to the project manager in writing.

D. Comply with most current edition of Northwestern University Design Standards.

E. All materials and installations shall meet applicable FM Global requirements.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.13 COORDINATION

A. Contractor shall coordinate the work of the different trades so that interference between piping, equipment, structural, and electrical work will be avoided. All necessary offsets in piping and ductwork, and all fittings, and other components, required to install the work properly shall be furnished complete in place at no additional cost.

B. Unless otherwise stipulated under a particular heading, the following rules relative to responsibilities of the Contractors and Subcontractors will apply:

1. Make-up water piping connections shall be provided by the Plumbing Contractor to within five (5) feet of the required point of connection to the equipment and there terminated with a shut-off valve. Each trade shall make the final connection to the equipment it installs.
2. Ceiling access panels will be installed by the General Contractor at locations determined by the Plumbing Contractor.
3. The Plumbing Contractor or subcontractor shall install all roughing-in pertaining to his trade for each item of equipment furnished under another Section of the Specifications or by the Owner.
4. The Plumbing Contractor shall make final connections of equipment to rough-ins.

1.14 EQUIPMENT START-UP

A. Start-up of all plumbing equipment shall be video-recorded by the plumbing contractor. Two DVD copies shall be turned over to the Owner's maintenance staff.

1.15 TESTING AND REPAIR

A. All piping and ductwork systems shall be thoroughly cleaned and flushed prior to final testing.

B. Pressure testing shall be completed for the following piping systems:

1. Domestic water, sanitary and vent, storm and gas piping systems, and other systems as noted on the plans.

C. All testing must be witnessed and accurately recorded noting methods of testing, times, dates, and results.

D. Any damage as a result of tests shall be repaired or damaged materials replaced at no cost to the Owner.

1.16 FINAL COMPLETION

A. All work shall be cleaned prior to issuance of Substantial Completion.

B. Retouch or repaint factory painted prime and finish coats where scratched or damaged.

C. Deliver any equipment as required by this Specification to Owner and obtained signed receipts of delivery.

D. Clean equipment, restore damaged materials, and leave the Work inacceptable condition.

E. Remove all site tools, equipment, surplus materials and rubbish continuously at no additional cost to the Owner.

F. Contractor shall submit written certificates warranting each item ofequipment.

1.17 OPERATING AND MAINTENANCE MANUALS

A. Refer to Section 01.77.00 Close Out Procedures for the Operating and Maintenance Manual requirements for this Contract..

B. The Plumbing subcontractor shall provide the Contractor two (2) sets of operating and maintenance instructions of all plumbing and electrical equipment furnished and installed under this section.

C. The Contractor shall collect the operating instructions, bind them into two complete sets and deliver them to the Architect who will check for completeness and deliver them to the Owner.

D. Delivery of the operating and maintenance manuals shall be a condition precedent to final payment.

1.18 INSTRUCTIONS OF OWNER PERSONNEL

A. Refer to Section 01.77.00 for the Instruction of Owner's Personnel requirements for this Contract.

B. The Plumbing subcontractor shall instruct the Owner's personnel, at the site, in the use and maintenance of equipment installed under this section.

C. Submission to the Architect of a certificate of compliance to this requirement, signed by the Contractor and the Owner's Representative shall be a condition precedent to final payment.

1.19 GUARANTEE AND SERVICE

A. Notwithstanding any other requirements of this contract, the Plumbing Subcontractor shall guarantee the performance of the installation and equipment included in this Section for one year from the date of Substantial Completion as defined in Article 9.6 of the General Conditions. Should any defects in materials or workmanship appear during this period, they shall be corrected or replaced by the Plumbing Subcontractor to the satisfaction of the Architect, and at no expense to the Owner.

1.20 PERMIT

A. The subcontractor's attention is directed to subparagraph 4.16 of the General Conditions and Specification Section 01.41.23 Fees and Permits.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS:

A. All equipment and materials shall be furnished in strict accordance with the equipment named and according to Specification requirements. Each bid shall be based upon one of the materials or manufacturers specified.

B. Equipment and materials specified shall be considered to have prior approval, but submittal for approval is required. Furnish construction drawings to other Contractors when required to coordinate construction.

C. Where multiple manufacturers are named the drawings and specifications are based on the requirements and layouts for the equipment of the first named manufacturer. Any change required by the use of other named manufacturers such as revisions to foundations, bases, piping, controls, wiring, openings, and appurtenances shall be made by the Contractor at no additional cost to the Owner.

2.2 PIPE, TUBE, AND FITTINGS - GENERAL

A. Refer to individual Division 22 Piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 GROUT

A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cementgrout.

1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION (When indicated on the drawings)

A. Refer to applicable Division 01 Section covering cutting and patching and applicable Division 02 Section covering selective structure demolition for general demolition requirements and procedures.

B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

C. All unused waste, water and vent that is no longer in service shall be removed from ceilings, walls and floors. No dead piping will be allowed to stay. Underground piping shall also be removed. If piping cannot be removed underground it shall be capped at the main and the pipe shall be pumped and filled with a flowable fill.

D. A MOP will be required when filling abandoned sewers, old water mains or any plumbing piping that is buried in the ground.

E. Before abandoning any plumbing piping underground, the piping shall be inspected, video recorded, mapped on an as built and FMDC and FMO shall approve abandoning the piping.

F. After completion of of all work, all of the sewer systems involved with the project in their entirety, shall be thoroughly cleaned out to remove all grit, or other foreign matter. This shall include the use of a camera and recording to a flash drive or DVD and a copy of the recording included with the close out documents.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. All materials and/or equipment shall be installed per manufacturer's recommendations and instructions.

B. When temporary water is required, an approved backflow device shall be used and testing reports from device shall be sent to FMO plumbing foreman for verification.

C. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

D. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

E. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

F. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

G. Piping shall not project beyond walls or steel lines nor shall it hang below slabs more than is

absolutely necessary. Particular attention shall be paid to the required clearances.

H. Offset piping where required to avoid interference with other work, to provide greater headroom or clearance, or to conceal pipe more readily. Offsets shall be properly drained or trapped where necessary.

I. Provide swing joints and expansion bends wherever required to allow the piping to expand without undue stress to connections or equipment.

J. Exposed piping around fixtures or in other conspicuous places shall not show tool marks at fittings.

K. Isolate pipe from the building construction to prevent transmission of vibration to the structure and to eliminate noise.

L. Install piping such that any equipment connected to piping may be removed by disconnecting two (2) flanges or unions and removing only one or two pipe sections. All equipment shall have bolted or screwed flanges or unions at pipe connections.

M. Install fittings for changes in direction and branch connections. T-drill system for mechanically formed tee connections and couplings, and Victaulic hole cut piping system are not allowed.

N. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.

O. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

P. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

Q. Install piping to permit valve servicing.

R. Install piping at indicated slopes.

S. Install piping free of sags and bends.

T. Install piping to allow application of insulation.

U. Eccentric reducing couplings shall be provided in all cases where air or water pockets would otherwise occur due to a reduction in pipe size.

V. Cap and plug all openings in pipes during construction with suitable metal plugs or cap to keep out dirt and rubbish until equipment is connected.

W. Install drains, consisting of a tee fitting, NPS 3/4 full port-ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

X. Select system components with pressure rating equal to or greater than system operating pressure.

Y. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

Z. Verify final equipment locations for roughing-in.

AA. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

BB. Provide proper access to materials and equipment that require inspection, repair, service, or maintenance.

CC. Minimum service access size for materials equipment/components above ceilings shall be 24" square.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

3.4 PIPING CONNECTIONS

A. Pipe sizes indicated shall be carried full size to equipment served. Any change of size to

match equipment connection shall be made within one foot of the equipment. At temperature control valves with sizes smaller than connected lines, reduction shall be made immediately adjacent to valves.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install Plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.6 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit. Install dowel rods to connect concrete base to concrete floor.
2. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section “Cast-in-Place Concrete”

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor Plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

A. Mix and install grout for Plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION

SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
   1. Provide Payment and Performance Bonds for the full value of their Subcontract.
   2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
   1. Comply with the Instructions to Bidders.
   2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
   3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
   4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
      FILED SUBCONTRACTOR'S BID FOR SECTION:
      22 00 00 – COMMON WORK RESULTS FOR PLUMBING

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
   1. All subcontractors to the Filed Subcontractor, whose work is:
      a. Valued at $10,000 or more.
   2. The contract sum for each subcontractor required to be listed.
      a. An affidavit that all subcontractors named on the Filed Subcontractor's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
   3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
   4. Comply with the applicable New York General Laws and the following:
      a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the

Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None.	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. P0.01 – Plumbing Schedules and Details
2. P0.02 – Plumbing Notes
3. P0.03 – SMT Rough-In Details
4. P0.04 – Sanitary Waste and Natural Gas Riser Diagrams
5. P1.01 – Sanitary Plan
6. P2.01 – Water Piping Plan
7. P3.01 – Natural Medical/Gas and Storm Drainage Plan
8. P3.02 – Roof Natural Gas and Storm Drainage Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 22 00 00 – Common Work Results for Plumbing
2. Section 22 05 13 – Common Motor Requirements for Plumbing Equipment
3. Section 22 05 16 – Expansion Fittings and Loops for Plumbing Piping
4. Section 22 05 17 – Sleeves and Sleeve Seals for Plumbing
5. Section 22 05 18 – Escutcheons for Plumbing Piping
6. Section 22 05 19 – Meter and Gauges for Plumbing
7. Section 22 05 23 – General Duty Valves for Plumbing Piping
8. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
9. Section 22 05 48 – Vibration Controls for Plumbing Piping and Equipment
10. Section 22 05 53 – Identification for Plumbing Piping and Equipment
11. Section 22 07 00 – Plumbing Insulation
12. Section 22 08 00 – Commissioning of Plumbing Systems
13. Section 22 10 00 – Plumbing Equipment
14. Section 22 11 18 – Domestic Water Distribution System
15. Section 22 11 19 – Plumbing Specialties
16. Section 22 13 16 – Sanitary Waste and Vent Piping
17. Section 22 13 19 – Sanitary Waste Piping Specialties
18. Section 22 31 00 – Domestic Water Softeners
19. Section 22 34 00 – Domestic Water Heaters
20. Section 22 40 00 – Plumbing Fixtures

B. Alternates: None.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.4 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.5 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in plumbing equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.
C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Rotor: Random-wound, squirrel cage.

F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating.

H. Insulation: Class F.

I. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.

2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.

4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 220516 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 – GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
   1. Provide Payment and Performance Bonds for the full value of their Subcontract.
   2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
   1. Comply with the Instructions to Bidders.
   2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
   3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
   4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
      FILED SUBCONTRACTOR'S BID FOR SECTION:
      22 05 16 – COMMON FITTINGS AND LOOPS FOR PLUMBING PIPING

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
   1. All subcontractors to the Filed Subcontractor, whose work is:
      a. Valued at $10,000 or more.
   2. The contract sum for each subcontractor required to be listed.
      a. An affidavit that all subcontractors named on the Filed Subcontractor's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
   3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
   4. Comply with the applicable New York General Laws and the following:
      a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the

Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None.	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. P0.01 – Plumbing Schedules and Details
2. P0.02 – Plumbing Notes
3. P0.03 – SMT Rough-In Details
4. P0.04 – Sanitary Waste and Natural Gas Riser Diagrams
5. P1.01 – Sanitary Plan
6. P2.01 – Water Piping Plan
7. P3.01 – Natural Medical/Gas and Storm Drainage Plan
8. P3.02 – Roof Natural Gas and Storm Drainage Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 22 00 00 – Common Work Results for Plumbing
2. Section 22 05 13 – Common Motor Requirements for Plumbing Equipment
3. Section 22 05 16 – Expansion Fittings and Loops for Plumbing Piping
4. Section 22 05 17 – Sleeves and Sleeve Seals for Plumbing
5. Section 22 05 18 – Escutcheons for Plumbing Piping
6. Section 22 05 19 – Meter and Gauges for Plumbing
7. Section 22 05 23 – General Duty Valves for Plumbing Piping
8. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
9. Section 22 05 48 – Vibration Controls for Plumbing Piping and Equipment
10. Section 22 05 53 – Identification for Plumbing Piping and Equipment
11. Section 22 07 00 – Plumbing Insulation
12. Section 22 08 00 – Commissioning of Plumbing Systems
13. Section 22 10 00 – Plumbing Equipment
14. Section 22 11 18 – Domestic Water Distribution System
15. Section 22 11 19 – Plumbing Specialties
16. Section 22 13 16 – Sanitary Waste and Vent Piping
17. Section 22 13 19 – Sanitary Waste Piping Specialties
18. Section 22 31 00 – Domestic Water Softeners
19. Section 22 34 00 – Domestic Water Heaters
20. Section 22 40 00 – Plumbing Fixtures

B. Alternates: None.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.4 SUMMARY

A. Section Includes:

1. Flexible-hose packless expansion joints.
2. Grooved-joint expansion joints.
3. Alignment guides and anchors.
4. Pipe loop installation.

1.5 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Delegated-Design Submittal: For each anchor and alignment guide 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. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.
4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.7 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of expansion joint, from manufacturer.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For expansion joints to include in maintenance manuals.

1.9 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 PACKLESS EXPANSION JOINTS

A. Flexible-Hose Packless Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Flex-Hose Co., Inc.
   b. Flexicraft Industries.
   c. Metraflex, Inc.

2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible- metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
4. Expansion Joints for Copper Tubing NPS 2 (DN 50) and Smaller: Copper-alloy fittings with solder-joint end connections.

   a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F (3100 kPa at 21 deg C) and 340 psig at 450 deg F (2340 kPa at 232 deg C) ratings.

5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Copper-alloy fittings with threaded end connections.

   a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F (2070 kPa at 21 deg C) and 225 psig at 450 deg F (1550 kPa at 232 deg C) ratings.

6. Expansion Joints for Steel Piping NPS 2 (DN 50) and Smaller: Stainless-steel fittings with threaded end connections.

a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F (3100 kPa at 21 deg C) and 325 psig at 600 deg F (2250 kPa at 315 deg C) ratings.

7. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6 (DN 65 to DN 150): Stainless-steel fittings with flanged end connections.

a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F (1380 kPa at 21 deg C) and 145 psig at 600 deg F (1000 kPa at 315 deg C) ratings.

8. Expansion Joints for Steel Piping NPS 8 to NPS 12 (DN 200 to DN 300): Stainless-steel fittings with flanged end connections.

a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 125 psig at 70 deg F (860 kPa at 21 deg C) and 90 psig at 600 deg F (625 kPa at 315 deg C) ratings.

2.2 GROOVED-JOINT EXPANSION JOINTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Victaulic Company.

B. Description: Factory-assembled expansion joint made of several grooved-end pipe nipples, couplings, and grooved joints.

C. Standard: AWWA C606, for grooved joints.

D. Nipples: Galvanized, ASTM A 53/A 53M, Schedule 40, Type E or S, steel pipe with grooved ends.

E. Couplings: Five, seven, ten, or twelve, flexible type for steel-pipe dimensions. Include ferrous housing sections, Buna-N or EPDM gaskets suitable for project duties, and bolts and nuts.

2.3 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Adsco Manufacturing LLC.
b. Advanced Thermal Systems, Inc.
c. Flex-Hose Co., Inc.
d. Flexicraft Industries.
e. Hyspan Precision Products, Inc.
f. Metraflex, Inc.
g. Unisource Manufacturing, Inc.
h. U.S. Bellows, Inc.

2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.

3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.

a. Stud: Threaded, zinc-coated carbon steel.
b. Expansion Plug: Zinc-coated steel.
c. Washer and Nut: Zinc-coated steel.

5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.

a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
b. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

B. Install grooved-joint expansion joints to grooved-end steel piping

3.2 PIPE LOOP INSTALLATION

A. Connect risers and branch connections to mains with at least five pipe fittings including tee in main.

B. Connect risers and branch connections to terminal units with at least four pipe fittings including tee in riser.

C. Connect mains and branch connections to terminal units with at least four pipe fittings including tee in main.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install two guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Black-Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
2. Anchor Attachment to Galvanized-Steel Pipe: Attach with pipe hangers. Use MSS SP-69, Type 42, riser clamp welded to anchor.
3. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow

fastener manufacturer's written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 – GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
   1. Provide Payment and Performance Bonds for the full value of their Subcontract.
   2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
   1. Comply with the Instructions to Bidders.
   2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
   3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
   4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
      FILED SUBCONTRACTOR'S BID FOR SECTION:
      22 05 17 – SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
   1. All subcontractors to the Filed Subcontractor, whose work is:
      a. Valued at $10,000 or more.
   2. The contract sum for each subcontractor required to be listed.
      a. An affidavit that all subcontractors named on the Filed Subcontractor's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
   3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
   4. Comply with the applicable New York General Laws and the following:
      a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the

Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None.	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. P0.01 – Plumbing Schedules and Details
2. P0.02 – Plumbing Notes
3. P0.03 – SMT Rough-In Details
4. P0.04 – Sanitary Waste and Natural Gas Riser Diagrams
5. P1.01 – Sanitary Plan
6. P2.01 – Water Piping Plan
7. P3.01 – Natural Medical/Gas and Storm Drainage Plan
8. P3.02 – Roof Natural Gas and Storm Drainage Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 22 00 00 – Common Work Results for Plumbing
2. Section 22 05 13 – Common Motor Requirements for Plumbing Equipment
3. Section 22 05 16 – Expansion Fittings and Loops for Plumbing Piping
4. Section 22 05 17 – Sleeves and Sleeve Seals for Plumbing
5. Section 22 05 18 – Escutcheons for Plumbing Piping
6. Section 22 05 19 – Meter and Gauges for Plumbing
7. Section 22 05 23 – General Duty Valves for Plumbing Piping
8. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
9. Section 22 05 48 – Vibration Controls for Plumbing Piping and Equipment
10. Section 22 05 53 – Identification for Plumbing Piping and Equipment
11. Section 22 07 00 – Plumbing Insulation
12. Section 22 08 00 – Commissioning of Plumbing Systems
13. Section 22 10 00 – Plumbing Equipment
14. Section 22 11 18 – Domestic Water Distribution System
15. Section 22 11 19 – Plumbing Specialties
16. Section 22 13 16 – Sanitary Waste and Vent Piping
17. Section 22 13 19 – Sanitary Waste Piping Specialties
18. Section 22 31 00 – Domestic Water Softeners
19. Section 22 34 00 – Domestic Water Heaters
20. Section 22 40 00 – Plumbing Fixtures

B. Alternates: None.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.4 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Smith, Jay R. Mfg. Co.
2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
   1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Advance Products & Systems, Inc.
   2. CALPICO, Inc.
   3. Metraflex Company (The).
   4. Pipeline Seal and Insulator, Inc.
   5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

   1. Sealing Elements: EPDM-rubber or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   2. Pressure Plates: Carbon steel or stainless steel.
   3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, or stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Presealed Systems.

B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.

2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.

2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

a. Piping Smaller Than [NPS 6 (DN 150)]: Cast-iron wall sleeves or galvanized-steel- pipe sleeves.

b. Piping NPS 6 (DN 150) and Larger: Cast-iron wall sleeves or galvanized-steel-pipe sleeves.

2. Exterior Concrete Walls below Grade:

a. Piping Smaller than NPS 6 (DN 150): Cast-iron wall sleeves with sleeve-seal system or galvanized-steel-pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 (DN 150) and Larger: Cast-iron wall sleeves with sleeve-seal system or galvanized-steel-pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

a. Piping Smaller than NPS 6 (DN 150): Cast-iron floor sleeves with sleeve-seal system, galvanized-steel-pipe sleeves with sleeve-seal system, or Sleeve-seal fittings.

1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 (DN 150) and Larger: Cast-iron floor sleeves with sleeve-seal system, galvanized-steel-pipe sleeves with sleeve-seal system, or galvanized-steel-pipe sleeves.

1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

a. Piping Smaller Than NPS 6 (DN 150) : Galvanized-steel-pipe sleeves, stack-sleeve fittings, or Sleeve-seal fittings.
b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves or stack-sleeve fittings.

5. Interior Partitions:

a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves.
b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
   1. Provide Payment and Performance Bonds for the full value of their Subcontract.
   2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
   1. Comply with the Instructions to Bidders.
   2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
   3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
   4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
      FILED SUBCONTRACTOR'S BID FOR SECTION:
      22 05 18 – ESCUTCHEONS FOR PLUMBING PIPING

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
   1. All subcontractors to the Filed Subcontractor, whose work is:
      a. Valued at $10,000 or more.
   2. The contract sum for each subcontractor required to be listed.
      a. An affidavit that all subcontractors named on the Filed Subcontractor's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
   3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
   4. Comply with the applicable New York General Laws and the following:
      a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the

Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None.	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. P0.01 – Plumbing Schedules and Details
2. P0.02 – Plumbing Notes
3. P0.03 – SMT Rough-In Details
4. P0.04 – Sanitary Waste and Natural Gas Riser Diagrams
5. P1.01 – Sanitary Plan
6. P2.01 – Water Piping Plan
7. P3.01 – Natural Medical/Gas and Storm Drainage Plan
8. P3.02 – Roof Natural Gas and Storm Drainage Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 22 00 00 – Common Work Results for Plumbing
2. Section 22 05 13 – Common Motor Requirements for Plumbing Equipment
3. Section 22 05 16 – Expansion Fittings and Loops for Plumbing Piping
4. Section 22 05 17 – Sleeves and Sleeve Seals for Plumbing
5. Section 22 05 18 – Escutcheons for Plumbing Piping
6. Section 22 05 19 – Meter and Gauges for Plumbing
7. Section 22 05 23 – General Duty Valves for Plumbing Piping
8. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
9. Section 22 05 48 – Vibration Controls for Plumbing Piping and Equipment
10. Section 22 05 53 – Identification for Plumbing Piping and Equipment
11. Section 22 07 00 – Plumbing Insulation
12. Section 22 08 00 – Commissioning of Plumbing Systems
13. Section 22 10 00 – Plumbing Equipment
14. Section 22 11 18 – Domestic Water Distribution System
15. Section 22 11 19 – Plumbing Specialties
16. Section 22 13 16 – Sanitary Waste and Vent Piping
17. Section 22 13 19 – Sanitary Waste Piping Specialties
18. Section 22 31 00 – Domestic Water Softeners
19. Section 22 34 00 – Domestic Water Heaters
20. Section 22 40 00 – Plumbing Fixtures

B. Alternates: None.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.4 SUMMARY

A. Section Includes:

1. Escutcheons.
2. Floor plates.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
g. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.
2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
1. Provide Payment and Performance Bonds for the full value of their Subcontract.
2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
1. Comply with the Instructions to Bidders.
2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
FILED SUBCONTRACTOR'S BID FOR SECTION:
22 05 19 – MEERS AND GAGES

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
1. All subcontractors to the Filed Subcontractor, whose work is:
a. Valued at $10,000 or more.
2. The contract sum for each subcontractor required to be listed.
a. An affidavit that all subcontractors named on the Filed Subcontractor's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
4. Comply with the applicable New York General Laws and the following:
a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the

Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None.	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. P0.01 – Plumbing Schedules and Details
2. P0.02 – Plumbing Notes
3. P0.03 – SMT Rough-In Details
4. P0.04 – Sanitary Waste and Natural Gas Riser Diagrams
5. P1.01 – Sanitary Plan
6. P2.01 – Water Piping Plan
7. P3.01 – Natural Medical/Gas and Storm Drainage Plan
8. P3.02 – Roof Natural Gas and Storm Drainage Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 22 00 00 – Common Work Results for Plumbing
2. Section 22 05 13 – Common Motor Requirements for Plumbing Equipment
3. Section 22 05 16 – Expansion Fittings and Loops for Plumbing Piping
4. Section 22 05 17 – Sleeves and Sleeve Seals for Plumbing
5. Section 22 05 18 – Escutcheons for Plumbing Piping
6. Section 22 05 19 – Meter and Gauges for Plumbing
7. Section 22 05 23 – General Duty Valves for Plumbing Piping
8. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
9. Section 22 05 48 – Vibration Controls for Plumbing Piping and Equipment
10. Section 22 05 53 – Identification for Plumbing Piping and Equipment
11. Section 22 07 00 – Plumbing Insulation
12. Section 22 08 00 – Commissioning of Plumbing Systems
13. Section 22 10 00 – Plumbing Equipment
14. Section 22 11 18 – Domestic Water Distribution System
15. Section 22 11 19 – Plumbing Specialties
16. Section 22 13 16 – Sanitary Waste and Vent Piping
17. Section 22 13 19 – Sanitary Waste Piping Specialties
18. Section 22 31 00 – Domestic Water Softeners
19. Section 22 34 00 – Domestic Water Heaters
20. Section 22 40 00 – Plumbing Fixtures

B. Alternates: None.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.4 SUMMARY

A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Liquid-in-glass thermometers.
3. Thermowells.
4. Dial-type pressure gages.
5. Test plugs and test plug kits.
6. Gage attachments.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product certificates.

C. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ashcroft Inc.
2. Trerice, H. O. Co.
3. Weiss Instruments, Inc.

B. Standard: ASME B40.200.

C. Case: Liquid-filled and sealed type(s); stainless steel with 3-inch nominal diameter.

D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.

E. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.

F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.

G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.

H. Window: Plain glass.

I. Ring: Stainless steel.

J. Element: Bimetal coil.

K. Pointer: Dark-colored metal.

L. Accuracy: Plus or minus 1 percent of scale range.

2.2 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Trerice, H. O. Co.
   b. Weiss Instruments, Inc.
   c. Winters Instruments - U.S.

2. Standard: ASME B40.200.
3. Case: Cast aluminum; 9-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass.
8. Stem: Aluminum and of length to suit installation.

   a. Design for Thermowell Installation: Bare stem.

9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of
    1.5 percent of scale range.

B. Plastic-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ernst Flow Industries.
b. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
c. Weiss Instruments, Inc.

2. Standard: ASME B40.200.
3. Case: Plastic; 9-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass.
8. Stem: Aluminum and of length to suit installation.
   a. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of
    1.5 percent of scale range.

2.3 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.4 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Ashcroft Inc.
   b. Trerice, H. O. Co.
   c. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   d. Weiss Instruments, Inc.

2. Standard: ASME B40.100.
3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Metal.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

B. Direct-Mounted, Plastic-Case, Dial-Type Pressure Gages:

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. Ashcroft Inc.
   b. Marsh Bellofram.
   c. Trerice, H. O. Co.
   d. Weiss Instruments, Inc.

2. Standard: ASME B40.100.
3. Case: Sealed type; plastic; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

C. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Ashcroft Inc.
    b. Marsh Bellofram.
    c. Trerice, H. O. Co.
    d. Weiss Instruments, Inc.

2. Standard: ASME B40.100.
3. Case: Liquid-filled type; cast aluminum or drawn steel; 4-1/2-inch nominal diameter with back flange and holes for panel mounting.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass or plastic.
10. Ring: Metal.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

D. Remote-Mounted, Plastic-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Ashcroft Inc.
    b. Trerice, H. O. Co.
    c. Weiss Instruments, Inc.

2. Standard: ASME B40.100.
3. Case: Sealed type; plastic; 4-1/2-inch nominal diameter with back flange and holes for panel mounting.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass or plastic.
10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.5 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 (DN 8) or NPS 1/2 (DN 15), ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F (3450 kPa at 93 deg C).

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM or neoprene or Nordel, but all potable water rated.

2.6 TEST-PLUG KITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flow Design, Inc.
2. Miljoco Corporation.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

B. Furnish two test-plug kit(s) containing two thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-)

diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F (minus 4 to plus 52 deg C).

D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- (25- to 51-mm-) diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F (minus 18 to plus 104 deg C).

E. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- (51- to 76-mm-) diameter dial and probe. Dial range shall be at least 0 to 200 psig (0 to 1380 kPa).

F. Carrying Case: Metal or plastic, with formed instrument padding.

2.7 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.

B. Valves: Brass or stainless-steel needle, with NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe threads.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending a minimum of 2 inches into fluid and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

H. Install remote-mounted pressure gages on panel.

I. Install valve and snubber in piping for each pressure gage for fluids.

J. Install thermometers in the following locations:

1. Inlet and outlet of each water heater.

K. Install pressure gages in the following locations:

1. Building water service entrance into building.
2. Inlet and outlet of each pressure-reducing valve.
3. Suction and discharge of each domestic water pump.

L. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

M. Adjust faces of meters and gages to proper angle for best visibility.

3.2 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:

1. Liquid-filled, bimetallic-actuated type.
2. Industrial-style, liquid-in-glass type.

B. Thermometer stems shall be of length to match thermowell insertion length.

3.3 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Domestic Cold-Water Piping: 0 to 100 deg F.

B. Scale Range for Domestic Hot-Water Piping: 0 to 250 deg F.

3.4 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each water service into building shall be one of the following:

1. Liquid-filled Sealed, direct-mounted, metal case.
2. Sealed, direct-mounted, plastic case.

B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be one of the following:

1. Liquid-filled Sealed Open-front, pressure-relief Solid-front, pressure-relief Insert type,

direct-mounted, metal case.
2. Sealed, direct-mounted, plastic case.

C. Pressure gages at suction and discharge of each domestic water pump shall be one of the following:

1. Liquid-filled, -mounted, metal case.
2. Sealed, direct-mounted, plastic case.

3.5 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service Piping: 0 to 100 psi.

B. Scale Range for Domestic Water Piping: 0 to 160 psi.

END OF SECTION

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
   1. Provide Payment and Performance Bonds for the full value of their Subcontract.
   2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
   1. Comply with the Instructions to Bidders.
   2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
   3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
   4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
      FILED SUBCONTRACTOR'S BID FOR SECTION:
      22 05 23 – GENERAL-DUTY VALVES FOR PLUMBING PIPING

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
   1. All subcontractors to the Filed Subcontractor, whose work is:
      a. Valued at $10,000 or more.
   2. The contract sum for each subcontractor required to be listed.
      a. An affidavit that all subcontractors named on the Filed Subcontractor's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
   3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
   4. Comply with the applicable New York General Laws and the following:
      a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with

persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None.	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. P0.01 – Plumbing Schedules and Details
2. P0.02 – Plumbing Notes
3. P0.03 – SMT Rough-In Details
4. P0.04 – Sanitary Waste and Natural Gas Riser Diagrams
5. P1.01 – Sanitary Plan
6. P2.01 – Water Piping Plan
7. P3.01 – Natural Medical/Gas and Storm Drainage Plan
8. P3.02 – Roof Natural Gas and Storm Drainage Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 22 00 00 – Common Work Results for Plumbing
2. Section 22 05 13 – Common Motor Requirements for Plumbing Equipment
3. Section 22 05 16 – Expansion Fittings and Loops for Plumbing Piping
4. Section 22 05 17 – Sleeves and Sleeve Seals for Plumbing
5. Section 22 05 18 – Escutcheons for Plumbing Piping
6. Section 22 05 19 – Meter and Gauges for Plumbing
7. Section 22 05 23 – General Duty Valves for Plumbing Piping
8. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
9. Section 22 05 48 – Vibration Controls for Plumbing Piping and Equipment
10. Section 22 05 53 – Identification for Plumbing Piping and Equipment
11. Section 22 07 00 – Plumbing Insulation
12. Section 22 08 00 – Commissioning of Plumbing Systems
13. Section 22 10 00 – Plumbing Equipment
14. Section 22 11 18 – Domestic Water Distribution System
15. Section 22 11 19 – Plumbing Specialties
16. Section 22 13 16 – Sanitary Waste and Vent Piping
17. Section 22 13 19 – Sanitary Waste Piping Specialties
18. Section 22 31 00 – Domestic Water Softeners
19. Section 22 34 00 – Domestic Water Heaters
20. Section 22 40 00 – Plumbing Fixtures

B. Alternates: None.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary

Conditions and Division 01 Specification Sections, apply to this Section.

1.4 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Bronze swing check valves.
3. Iron swing check valves.
4. Iron swing check valves with closure control.
5. Bronze globe valves.
6. Iron globe valves.
7. Chainwheels.

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.5 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.6 QUALITY ASSURANCE

A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

B. NSF Compliance: NSF 61 for valve materials for potable-water service.

C. To assure uniformity and compatibility, all grooved end valves and adjoining couplings shall be supplied by the same manufacturer.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-1/4 inch stem extensions and the following features:

1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Solder Joint: With sockets according to ASME B16.18.
3. Threaded: With threads according to ASME B1.20.1.
4. Grooved: With grooves according to ANSI/AWWA C606.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc. (Apollo)

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.

h. Stem: 316 Stainless Steel.
i. Ball: 316 Stainless Steel.
j. Port: Full.

2.3 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc. (Apollo)

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

2.4 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc. (Apollo)

2. Description:

a. Standard: MSS SP-71, Type I.
b. CWP Rating: 200 psig.
c. Body Design: Clear or full waterway.
d. Body Material: ASTM A 126, gray iron with bolted bonnet.
e. Ends: Flanged.
f. Trim: Bronze.
g. Gasket: Asbestos free.

2.5 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

A. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:

1. Description:

    a. Standard: MSS SP-71, Type I.
    b. CWP Rating: 200 psig.
    c. Body Design: Clear or full waterway.
    d. Body Material: ASTM A 126, gray iron with bolted bonnet.
    e. Ends: Flanged.
    f. Trim: Bronze.
    g. Gasket: Asbestos free.
    h. Closure Control: Factory-installed, exterior lever and spring.

2.6 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Conbraco Industries, Inc. (Apollo)

2. Description:

    a. Standard: MSS SP-80, Type 1.
    b. CWP Rating: 200 psig.
    c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
    d. Ends: Threaded or solder joint.
    e. Stem and Disc: Bronze.
    f. Packing: Asbestos free.
    g. Handwheel: Malleable iron.

2.7 IRON GLOBE VALVES

A. Class 125, Iron Globe Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Conbraco Industries, Inc. (Apollo)

2. Description:

    a. Standard: MSS SP-85, Type I.
    b. CWP Rating: 200 psig.
    c. Body Material: ASTM A 126, gray iron with bolted bonnet.

d. Ends: Flanged.
e. Trim: Bronze.
f. Packing and Gasket: Asbestos free.

2.8 CHAINWHEELS

A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
2. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve. Include zinc coating.
3. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

F. Install grooved end valves in accordance with the manufacturer's guidelines and recommendations. A representative shall provide on-site training for contractor's field personnel in the installation of grooved end valves. Factory-trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

3.2 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball valves.
2. Throttling Service: Globe or ball valves.
3. Pump-Discharge Check Valves:

    a. NPS 2 and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
    b. NPS 2-1/2 and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring.
    c. NPS 2-1/2 and Larger for Sanitary Waste and Storm Drainage: Iron swing check valves with lever and weight or spring.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve- end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Steel Piping, NPS 2 and Smaller: Threaded ends.

4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.4 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 125, bronze disc.
3. Ball Valves: Two piece, full port, 316 stainless steel with bronze trim.
4. Bronze Swing Check Valves: Class 125, bronze disc.
5. Bronze Globe Valves: Class 125, bronze disc.

B. Pipe NPS 2-1/2 and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Iron Swing Check Valves: Class 125, metal seats.
3. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.
4. Iron Globe Valves: Class 125.

END OF SECTION

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
1. Provide Payment and Performance Bonds for the full value of their Subcontract.
2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
1. Comply with the Instructions to Bidders.
2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
FILED SUBCONTRACTOR'S BID FOR SECTION:
22 05 29 – COMMON WORK RESULTS FOR PLUMBING

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
1. All subcontractors to the Filed Subcontractor, whose work is:
a. Valued at $10,000 or more.
2. The contract sum for each subcontractor required to be listed.
a. An affidavit that all subcontractors named on the Filed Subcontractor's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
4. Comply with the applicable New York General Laws and the following:
a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the

Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None.	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. P0.01 – Plumbing Schedules and Details
2. P0.02 – Plumbing Notes
3. P0.03 – SMT Rough-In Details
4. P0.04 – Sanitary Waste and Natural Gas Riser Diagrams
5. P1.01 – Sanitary Plan
6. P2.01 – Water Piping Plan
7. P3.01 – Natural Medical/Gas and Storm Drainage Plan
8. P3.02 – Roof Natural Gas and Storm Drainage Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 22 00 00 – Common Work Results for Plumbing
2. Section 22 05 13 – Common Motor Requirements for Plumbing Equipment
3. Section 22 05 16 – Expansion Fittings and Loops for Plumbing Piping
4. Section 22 05 17 – Sleeves and Sleeve Seals for Plumbing
5. Section 22 05 18 – Escutcheons for Plumbing Piping
6. Section 22 05 19 – Meter and Gauges for Plumbing
7. Section 22 05 23 – General Duty Valves for Plumbing Piping
8. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
9. Section 22 05 48 – Vibration Controls for Plumbing Piping and Equipment
10. Section 22 05 53 – Identification for Plumbing Piping and Equipment
11. Section 22 07 00 – Plumbing Insulation
12. Section 22 08 00 – Commissioning of Plumbing Systems
13. Section 22 10 00 – Plumbing Equipment
14. Section 22 11 18 – Domestic Water Distribution System
15. Section 22 11 19 – Plumbing Specialties
16. Section 22 13 16 – Sanitary Waste and Vent Piping
17. Section 22 13 19 – Sanitary Waste Piping Specialties
18. Section 22 31 00 – Domestic Water Softeners
19. Section 22 34 00 – Domestic Water Heaters
20. Section 22 40 00 – Plumbing Fixtures

B. Alternates: None.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.4 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Pipe positioning systems.
8. Equipment supports.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 220516 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
3. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.5 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.6 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.7 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

C. Delegated-Design Submittal: For trapeze hangers 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. Detail fabrication and assembly of trapeze hangers.
2. Design Calculations: Calculate requirements for designing trapeze hangers.

1.8 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.9 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pre-galvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel or stainless steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U- bolts.

2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.
c. Powerstrut
d. Unistrut Corporation; Tyco International, Ltd.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washers made of carbon steel.
7. Metallic Coating: Electroplated zinc or mill galvanized.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.
4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig (688-kPa), ASTM C 552, Type II cellular glass with 100-psig (688-kPa), or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 PIPE STANDS

A. General Requirements for Pipe Stands: 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.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
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:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
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 supports made from structural- steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.8 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon- steel shapes.

2.9 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-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 (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal 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 the building structure.

B. Metal 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 for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

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 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-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

G. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts,

washers, and other accessories.

I. Equipment Support Installation: Fabricate from welded-structural-steelshapes.

J. 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.

K. Install lateral bracing with pipe hangers and supports to preventswaying.

L. 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 (DN 65) 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.

M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

O. Insulated Piping:

1. Attach clamps and spacers to piping.

   a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
   b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
   c. Do not exceed pipe stress limits allowed by 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 adjoininginsulation.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight- distribution plate for pipe NPS 4 (DN 100) and larger if pipe is installed onrollers.

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 (DN 100) 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 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
   b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
   c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
   d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
   e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.

5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 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 bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and 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/D1.1M 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 so contours of welded surfaces match adjacent contours.

3.4 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 (40mm).

3.5 PAINTING

A. Touchup: 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 a minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in applicable Division 9 section(s).

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are 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 carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment

applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. 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 non-insulated or insulated, stationary pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F (566 deg C), pipes NPS 4 to NPS 24 (DN 100 to DN 600), requiring up to 4 inches (100 mm) of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 (DN 15 to DN 600) if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4 (DN 15 to DN 100), 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 (DN 20 to DN 200).
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8 (DN 10 to DN 200).
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3 (DN 10 to DN 80).
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).
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 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon- steel plate, 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 (DN 65 to DN 900) 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 (DN 25 to DN 750), from two 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 24 (DN 65 to DN 600), 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 (DN 50 to DN 1050) 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 (DN 50 to DN 600) 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 (DN 50 to DN 750) if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. 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 24 (DN 24 to DN 600).
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) if longer ends are required for riser clamps.

L. 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 (150 mm) for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) 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 (49 to 232 deg C) piping installations.

M. 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 (340 kg).
    b. Medium (MSS Type 32): 1500 lb (680 kg).
    c. Heavy (MSS Type 33): 3000 lb (1360 kg).

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.

N. 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.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1- 1/4 inches (32 mm).

3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. 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.

P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

S. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

SECTION 220548 - VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
1. Provide Payment and Performance Bonds for the full value of their Subcontract.
2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
1. Comply with the Instructions to Bidders.
2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
FILED SUBCONTRACTOR'S BID FOR SECTION:
22 05 48 – VIBRATION CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
1. All subcontractors to the Filed Subcontractor, whose work is:
    a. Valued at $10,000 or more.
2. The contract sum for each subcontractor required to be listed.
    a. An affidavit that all subcontractors named on the Filed Subcontractor's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
4. Comply with the applicable New York General Laws and the following:
    a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the

Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None.	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. P0.01 – Plumbing Schedules and Details
2. P0.02 – Plumbing Notes
3. P0.03 – SMT Rough-In Details
4. P0.04 – Sanitary Waste and Natural Gas Riser Diagrams
5. P1.01 – Sanitary Plan
6. P2.01 – Water Piping Plan
7. P3.01 – Natural Medical/Gas and Storm Drainage Plan
8. P3.02 – Roof Natural Gas and Storm Drainage Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 22 00 00 – Common Work Results for Plumbing
2. Section 22 05 13 – Common Motor Requirements for Plumbing Equipment
3. Section 22 05 16 – Expansion Fittings and Loops for Plumbing Piping
4. Section 22 05 17 – Sleeves and Sleeve Seals for Plumbing
5. Section 22 05 18 – Escutcheons for Plumbing Piping
6. Section 22 05 19 – Meter and Gauges for Plumbing
7. Section 22 05 23 – General Duty Valves for Plumbing Piping
8. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
9. Section 22 05 48 – Vibration Controls for Plumbing Piping and Equipment
10. Section 22 05 53 – Identification for Plumbing Piping and Equipment
11. Section 22 07 00 – Plumbing Insulation
12. Section 22 08 00 – Commissioning of Plumbing Systems
13. Section 22 10 00 – Plumbing Equipment
14. Section 22 11 18 – Domestic Water Distribution System
15. Section 22 11 19 – Plumbing Specialties
16. Section 22 13 16 – Sanitary Waste and Vent Piping
17. Section 22 13 19 – Sanitary Waste Piping Specialties
18. Section 22 31 00 – Domestic Water Softeners
19. Section 22 34 00 – Domestic Water Heaters
20. Section 22 40 00 – Plumbing Fixtures

B. Alternates: None.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.4 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Isolation mounts.
3. Freestanding spring isolators.
4. Housed spring mounts.
5. Elastomeric hangers.
6. Spring hangers.
7. Spring hangers with vertical-limit stops.
8. Pipe riser resilient supports.
9. Resilient pipe guides.

1.5 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.6 ACTION SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.

B. Delegated-Design Submittal: For vibration isolation details 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. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer and testing agency.

B. Welding certificates.

C. Field quality-control test reports.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Kinetics Noise Control.
2. Mason Industries.
3. Vibro-Acoustics.

B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene or rubber.

C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge- bearing neoprene as defined by AASHTO.

D. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- (6-mm-) thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

E. Housed Spring Mounts: Housed spring isolator.

1. Housing: Ductile-iron or steel housing.
2. Base: Factory drilled for bolting to structure.
3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch (6-mm) travel up or down before contacting a resilient collar.

F. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

G. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

H. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

I. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig (3.45 MPa) and for equal resistance in all directions.

J. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES, OSHPD, or an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits.

3.3 VIBRATION-CONTROL DEVICE INSTALLATION

A. Equipment Restraints:

1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inches (3.2 mm).

B. Install cables so they do not bend across edges of adjacent equipment or building structure.

C. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

D. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

F. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes

for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Northwestern University will engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Northwestern University, through Architect, before connecting anchorage device to restrained component (unless post connection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator deflection.
7. Test and adjust air-mounting system controls and safeties.
8. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of sprint isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
1. Provide Payment and Performance Bonds for the full value of their Subcontract.
2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
1. Comply with the Instructions to Bidders.
2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
FILED SUBCONTRACTOR'S BID FOR SECTION:
22 05 53 – INDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
1. All subcontractors to the Filed Subcontractor, whose work is:
   a. Valued at $10,000 or more.
2. The contract sum for each subcontractor required to be listed.
   a. An affidavit that all subcontractors named on the Filed Subcontractor's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
4. Comply with the applicable New York General Laws and the following:
   a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the

Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None.	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. P0.01 – Plumbing Schedules and Details
2. P0.02 – Plumbing Notes
3. P0.03 – SMT Rough-In Details
4. P0.04 – Sanitary Waste and Natural Gas Riser Diagrams
5. P1.01 – Sanitary Plan
6. P2.01 – Water Piping Plan
7. P3.01 – Natural Medical/Gas and Storm Drainage Plan
8. P3.02 – Roof Natural Gas and Storm Drainage Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 22 00 00 – Common Work Results for Plumbing
2. Section 22 05 13 – Common Motor Requirements for Plumbing Equipment
3. Section 22 05 16 – Expansion Fittings and Loops for Plumbing Piping
4. Section 22 05 17 – Sleeves and Sleeve Seals for Plumbing
5. Section 22 05 18 – Escutcheons for Plumbing Piping
6. Section 22 05 19 – Meter and Gauges for Plumbing
7. Section 22 05 23 – General Duty Valves for Plumbing Piping
8. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
9. Section 22 05 48 – Vibration Controls for Plumbing Piping and Equipment
10. Section 22 05 53 – Identification for Plumbing Piping and Equipment
11. Section 22 07 00 – Plumbing Insulation
12. Section 22 08 00 – Commissioning of Plumbing Systems
13. Section 22 10 00 – Plumbing Equipment
14. Section 22 11 18 – Domestic Water Distribution System
15. Section 22 11 19 – Plumbing Specialties
16. Section 22 13 16 – Sanitary Waste and Vent Piping
17. Section 22 13 19 – Sanitary Waste Piping Specialties
18. Section 22 31 00 – Domestic Water Softeners
19. Section 22 34 00 – Domestic Water Heaters
20. Section 22 40 00 – Plumbing Fixtures

B. Alternates: None.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.4 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Pipe labels.
3. Valve tags.
4. Warning tags.

1.5 ACTION 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. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

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 locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

1.7 WORK INCLUDED

A. Furnish and install nameplates, valve tags, valve charts, and pipe markers on all Plumbing equipment, and piping.

B. Provide nameplates with the unit number and service designation on all plumbing equipment.

C. Indicate all valve tag numbers on Record Drawings and submit framed under glass valve tag charts including valve service and location.

D. Install color coded ceiling tacks in acoustical tile ceilings or color coded tape on ceiling grid to identify location of equipment, valves and dampers that require regular maintenance or are part of a life safety system (fire dampers, smoke dampers, sprinkler valves or main isolation valves). Concealed fire protection valves shall be marked by red label triangles (3" equilateral) and circle dots (1" diameter). Triangles shall be placed on the wall nearest the valve with the apex pointing toward the ceiling tile. Dots shall be placed on border of ceiling tile.

E. Provide underground plastic pipe markers 6 to 8 inches below finish grade, directly above buried pipes.

F. Prepare valve charts and frame under glass. All valves and the tag numbers shall be shown on the Record As-Built Drawings.

G. Provide valve computer data base to match chart.

H. Prepare and install exterior protected brass plaques indicating underground service entrances.

PART 2 - PRODUCTS

2.1 GENERAL

A. Acceptable manufactures contingent on compliance with the specification.

1. Seton
2. Brady Corporation
3. Marking Services Incorporated

2.2 EQUIPMENT NAMEPLATES

A. Equipment nameplates shall be 3” x 6” long, 0.02” aluminum with a black enamel background with engraved natural aluminum letters similar to Seton Style 2065-20. Nameplate shall have pressure sensitive taped backing.

B. The nameplate shall contain the unit or equipment designation (“AHU” for air handling unit, “P” for circulating pump, etc.), unit number and area or system served.

C. Nameplates for exterior equipment shall be applied with waterproof adhesive.

2.3 PIPE IDENTIFICATION AND VALVE TAGS

A. All piping, except that piping which is within inaccessible chases, shall be identified with semi- rigid plastic identification markers equal to Seton Setmark pipe markers.

1. Direction of flow arrows are to be included on each marker.
2. Each marker background shall be appropriately color coded with a clearly printed legend to identify the contents of the pipe in conformance with the "Scheme for the Identification of Piping Systems" (ASME A13.1-1981).
3. Setmark snap-around markers shall be used for overall diameters up to 6" and strap-around markers shall be used above 6" overall diameters.
4. Markers shall be located:

a. Adjacent to each valve
b. At each branch
c. At each cap for future
d. At each riser takeoff,
e. At each pipe passage through wall (each side)
f. At each pipe passage at 20' – 0" intervals maximum.
g. At each piece of equipment.
h. At all access doors.
i. A minimum of one (1) marker shall be provided at each room.

5. Under ground pipe markers:

a. Provide detectable tape on all underground piping:
b. Labels shall be color coded and labeled the same as indoors.

B. Valve tags

1. All valves shall be designated by distinguishing numbers and letters carefully coordinated with a valve chart. Valve tags shall include what room(s) the valve serves and piece of equipment served.
2. Valve tags shall be color coded 0.032" anodized aluminum tags, with engraved letters similar to Seton S Type 250-BL or approved equal.

a. HVAC tags shall be round 2" diameter, similar to Seton 15426.
b. Plumbing tags shall be square 2" x 2" similar to Seton 42769.
c. Fire Protection tags shall be square 2" x 2" similar to Seton 42769 RED.
d. Lettering shall be ¼" high for type service and ½" for valve number. Tag shall indicate service and valve number.
e. Each service shall be a different color.

3. Tag shall be attached to valves with chain similar to Seton No 16 stainless steel jack chain.
4. Whenever a valve is above a hung ceiling, the valve tag shall be located immediately above the hung ceiling.
5. Provide a tag for every valve except:

    a. Perimeter radiation shut-off valves that are located at the finned tube radiation element within the accessible (from the space) heating enclosure

C. Furnish a minimum of two (2) typed valve lists

1. Each framed under glass or Plexiglas. Each chart shall be enclosed in an approved 0.015" thick plastic closure for permanent protection.
2. Valve numbers shall correspond to those indicated on the Record Drawings and on the printed valve lists.
3. The printed list shall include the valve number, location and purpose of each valve.
4. It shall state other necessary information such as the required opening or closing of another valve when one valve is to be opened or closed.
5. Printed framed valve lists shall be displayed in each Mechanical Room or in a location designated by Northwestern University.

D. Valve data base.

1. Provide a valve data base for all valves to operate on the building computer.
2. Every valve shall include:

    a. Tag Number
    b. Service (Hot water, Chilled water, Sprinkler, etc.)
    c. Size
    d. Operation
    e. Location
    f. Manufacture
    g. Model number
    h. Submittal reference

2.4 UTILITY ENTRANCE DESIGNATIONS

A. Provide a brass wall plaque, minimum 0.020" thickness, secured to the exterior wall just above the grade line for all buried service entrances or exits. Samples are: Water Service Below; Gas Service Below; Sanitary Sewer Below; Storm Sewer Below; Irrigation Water Below; etc.

B. Ceiling Tacks or Tape.

C. Provide steel color coded 3/4 inch diameter ceiling tacks in acoustical tile ceilings or color coded tape applied to ceiling grid to locate equipment, valves or dampers that require regular maintenance or are part of a Life Safety System.

D. The tacks or tapes shall be color codes as follows:

1. Yellow – HVAC
2. Red – Life Safety (fire dampers, sprinkler valves, etc.)
3. Green - Plumbing Valves.
4. Blue – Heating/Cooling Valves.

PART 3 - EXECUTION

3.1 PREPARATION

A. All surfaces shall be cleaned and insulated (if applicable) prior to installing any identification.

B. Exterior surfaces of outdoor equipment shall be dry and prepared to accept the specified identification.

3.2 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion. Seal with clear lacquer.

B. Install valve tags with chain.

C. Install plastic pipe markers in accordance with manufacturer's Instructions.

D. Install plastic tape markers complete around pipe in accordance with manufacturer's instructions.

E. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

F. Identify air handling units, pumps, domestic hot water heaters, fire pumps, heat transfer equipment tanks, water treatment devices, etc. with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.

G. Identify control panels and major control components outside panels with plastic nameplates.

H. Install detector tape on all underground services in accordance with the manufactures

recommendations.

I. Identify thermostats relating to air handling equipment serving multiple spaces.

J. Identify valves in main and branch piping with valve tags.

K. Tag automatic controls, instruments and relays. Key to control schematic.

L. Identify piping, concealed or exposed, with pipe markers or where buried using plastic tape pipe markers. Use tags on piping ¾ inch diameter and smaller. Identify service, flow direction and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
   1. Provide Payment and Performance Bonds for the full value of their Subcontract.
   2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
   1. Comply with the Instructions to Bidders.
   2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
   3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
   4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
      FILED SUBCONTRACTOR'S BID FOR SECTION:
      22 07 00 – PLUMBING INSULATION

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
   1. All subcontractors to the Filed Subcontractor, whose work is:
      a. Valued at $10,000 or more.
   2. The contract sum for each subcontractor required to be listed.
      a. An affidavit that all subcontractors named on the Filed Subcontractor's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
   3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
   4. Comply with the applicable New York General Laws and the following:
      a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the

Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None.	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. P0.01 – Plumbing Schedules and Details
2. P0.02 – Plumbing Notes
3. P0.03 – SMT Rough-In Details
4. P0.04 – Sanitary Waste and Natural Gas Riser Diagrams
5. P1.01 – Sanitary Plan
6. P2.01 – Water Piping Plan
7. P3.01 – Natural Medical/Gas and Storm Drainage Plan
8. P3.02 – Roof Natural Gas and Storm Drainage Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 22 00 00 – Common Work Results for Plumbing
2. Section 22 05 13 – Common Motor Requirements for Plumbing Equipment
3. Section 22 05 16 – Expansion Fittings and Loops for Plumbing Piping
4. Section 22 05 17 – Sleeves and Sleeve Seals for Plumbing
5. Section 22 05 18 – Escutcheons for Plumbing Piping
6. Section 22 05 19 – Meter and Gauges for Plumbing
7. Section 22 05 23 – General Duty Valves for Plumbing Piping
8. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
9. Section 22 05 48 – Vibration Controls for Plumbing Piping and Equipment
10. Section 22 05 53 – Identification for Plumbing Piping and Equipment
11. Section 22 07 00 – Plumbing Insulation
12. Section 22 08 00 – Commissioning of Plumbing Systems
13. Section 22 10 00 – Plumbing Equipment
14. Section 22 11 18 – Domestic Water Distribution System
15. Section 22 11 19 – Plumbing Specialties
16. Section 22 13 16 – Sanitary Waste and Vent Piping
17. Section 22 13 19 – Sanitary Waste Piping Specialties
18. Section 22 31 00 – Domestic Water Softeners
19. Section 22 34 00 – Domestic Water Heaters
20. Section 22 40 00 – Plumbing Fixtures

B. Alternates: None.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.4 SUMMARY

A. Section Includes:

1. Insulation Materials:

a. Flexible elastomeric.
b. Mineral fiber.
c. Polyolefin.

2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Sealants.
6. Factory-applied jackets.
7. Field-applied fabric-reinforcing mesh.
8. Field-applied jackets.
9. Tapes.
10. Securements.
11. Corner angles.

B. Related Sections include the following:

1. Division 23 Section "HVAC Insulation."

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.

6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA Inc.; Aerocel.

b. Armacell LLC; AP Armaflex.
c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

G. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Johns Manville; Micro-Lok.
b. Knauf Insulation; 1000 Pipe Insulation.
c. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

H. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Armacell LLC; Tubolit.
b. Nomaco Inc.; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.
c. RBX Corporation; Therma-cell.

2.2 INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Insulco, Division of MFS, Inc.; SmoothKote.
b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
c. Rock Wool Manufacturing Company; Delta One Shot.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA Inc.; Aeroseal.
b. Armacell LCC; 520 Adhesive.
c. Foster Products Corporation, H. B. Fuller Company; 85-75.
d. RBX Corporation; Rubatex Contact Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Chemical Company (The); 739, Dow Silicone.
b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
c. P.I.C. Plastics, Inc.; Welding Adhesive.
d. Speedline Corporation; Speedline Vinyl Adhesive.

2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-35.
b. Foster Products Corporation, H. B. Fuller Company; 30-90.
c. ITW TACC, Division of Illinois Tool Works; CB-50.
d. Marathon Industries, Inc.; 590.
e. Mon-Eco Industries, Inc.; 55-40.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-10.
b. Foster Products Corporation, H. B. Fuller Company; 35-00.
c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
d. Marathon Industries, Inc.; 550.
e. Mon-Eco Industries, Inc.; 55-50.

2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F.
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

2.5 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-76.
b. Foster Products Corporation, H. B. Fuller Company; 30-45.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Products, Division of ITW; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.
6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

a. Products: Subject to compliance with requirements, provide one of the following:

1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and

Saran 560 Vapor Retarder Film.

5. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

    a. Products: Subject to compliance with requirements, provide one of the following:

        1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

2.7 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for equipment and pipe.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Foster Products Corporation, H. B. Fuller Company; Mast-A-Fab.
    b. Vimasco Corporation; Elastafab 894.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Johns Manville; Zeston.
    b. P.I.C. Plastics, Inc.; FG Series.
    c. Proto PVC Corporation; LoSmoke.
    d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
b. Compac Corp.; 104 and 105.
c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
b. Compac Corp.; 110 and 111.
c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
b. Compac Corp.; 130.
c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
d. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.

2. Width: 3 inches.
3. Film Thickness: 4 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material

manufacturer to maintain vapor seal.

5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.3 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall

surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Division 07 Section "Penetration Firestopping" and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets,

valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless- steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its

attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.7 POLYOLEFIN INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at

end joints.

5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

D. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch- circumference limitallows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.9 FINISHES

A. Equipment and Pipe Insulation with ASJ or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket

material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, locations of welded strainers, locations of threaded valves, and locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.12 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold and Non-potable Cold Water: Insulation shall be one of the following:

1. Flexible Elastomeric: 1/2 inch thick for pipe sizes less than 1-1/2 inches, 1 inch thick for pipe sizes 2 inches and greater
2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick for pipe sizes less than 1- 1/2 inches, 1 inch thick for pipe sizes 2 inches and greater
3. Polyolefin: 1/2 inch thick for pipe sizes less than 1-1/2 inches, 1 inch thick for pipe sizes 2 inches and greater

B. Domestic Hot, and Re-circulated Hot Water and Tempered Water: Insulation shall be one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
3. Polyolefin: 1 inch thick.

C. Horizontal Stormwater and Emergency Drain: Insulation shall be one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
3. Polyolefin: 1 inch thick.

D. Roof Drain and Emergency Drain Bodies: Insulation shall be one of the following:

1. Flexible Elastomeric: 1 inch thick.
2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch Insert thickness thick.
3. Polyolefin: 1 inch thick.

E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops at lavatories shall be insulated and finished with Truebro Model No. 102 "Lav-Guard" or Brocar "Trap-Wrap" white insulation kit.

F. Sanitary Waste Piping Where Heat Tracing Is Installed, insulation shall be:

1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.

3.13 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Cold, Hot, and Recirculated Hot Water: Insulation shall be one of the following:

1. Flexible Elastomeric: 2 inches thick.
2. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

B. Sanitary Waste Piping Where Heat Tracing Is Installed: Insulation shall be:

1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.

3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field- applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor'soption.

C. Piping, Exposed:

1. PVC: 20 mils thick.

3.15 Aluminum, Smooth or Corrugated or Stucco Embossed: 0.016 inch thick.

END OF SECTION

SECTION 220800 - COMMISSIONING OF PLUMBING SYSTEMS

PART 1 -GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
1. Provide Payment and Performance Bonds for the full value of their Subcontract.
2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
1. Comply with the Instructions to Bidders.
2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
FILED SUBCONTRACTOR'S BID FOR SECTION:
22 08 00 – COMMISSIONING OF PLUMBING SYSTEMS

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
1. All subcontractors to the Filed Subcontractor, whose work is:
a. Valued at $10,000 or more.
2. The contract sum for each subcontractor required to be listed.
a. An affidavit that all subcontractors named on the Filed Subcontractor's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
4. Comply with the applicable New York General Laws and the following:
a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the

Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None.	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. P0.01 – Plumbing Schedules and Details
2. P0.02 – Plumbing Notes
3. P0.03 – SMT Rough-In Details
4. P0.04 – Sanitary Waste and Natural Gas Riser Diagrams
5. P1.01 – Sanitary Plan
6. P2.01 – Water Piping Plan
7. P3.01 – Natural Medical/Gas and Storm Drainage Plan
8. P3.02 – Roof Natural Gas and Storm Drainage Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 22 00 00 – Common Work Results for Plumbing
2. Section 22 05 13 – Common Motor Requirements for Plumbing Equipment
3. Section 22 05 16 – Expansion Fittings and Loops for Plumbing Piping
4. Section 22 05 17 – Sleeves and Sleeve Seals for Plumbing
5. Section 22 05 18 – Escutcheons for Plumbing Piping
6. Section 22 05 19 – Meter and Gauges for Plumbing
7. Section 22 05 23 – General Duty Valves for Plumbing Piping
8. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
9. Section 22 05 48 – Vibration Controls for Plumbing Piping and Equipment
10. Section 22 05 53 – Identification for Plumbing Piping and Equipment
11. Section 22 07 00 – Plumbing Insulation
12. Section 22 08 00 – Commissioning of Plumbing Systems
13. Section 22 10 00 – Plumbing Equipment
14. Section 22 11 18 – Domestic Water Distribution System
15. Section 22 11 19 – Plumbing Specialties
16. Section 22 13 16 – Sanitary Waste and Vent Piping
17. Section 22 13 19 – Sanitary Waste Piping Specialties
18. Section 22 31 00 – Domestic Water Softeners
19. Section 22 34 00 – Domestic Water Heaters
20. Section 22 40 00 – Plumbing Fixtures

B. Alternates: None.

1.3 SUMMARY

A. The purpose of this section is to specify the Division 22 responsibilities and participation in the Commissioning Process.

B. Work under this contract shall conform to requirements of Division 01, General Requirements, Conditions of the Contract, and Supplementary Conditions. This specification covers commissioning of plumbing systems which are part of this project.

C. Commissioning work shall be a team effort to ensure that all plumbing equipment and systems have been completely and properly installed, function together correctly to meet the design intent, and document system performance. Commissioning shall coordinate system documentation, equipment start-up, control system calibration, testing and balancing, and verification and performance testing.

D. The Commissioning Team shall be made up of representatives from the Owner, Design Team, General Contractor (GC), manufacturers, and construction trades. The trades represented on the Commissioning Team shall include, but not be limited to: mechanical (including sheet metal and piping), Building Automation System, Test and Balance, Electrical, Plumbing and other specialty trades as necessary; fitting, controls, test and balance, and electrical. The lead person for each trade who will actually perform or supervise the work is to be designated as the representative to the Commissioning Team. Responsibility for various steps of the Commissioning Process shall be divided among the members of the Commissioning Team, as described in this section.

E. The Commissioning Authority (CxA) shall have responsibility for coordinating and directing each step of the Commissioning Process.

F. Plumbing system installation, start-up, testing, balancing, preparation of O&M manuals and operator training are the responsibility of the Division 22 Contractors, with coordination, observation, verification and commissioning the responsibility of the General Contractor per Division 01, Section 01 9113. The 01 9113 Commissioning Process does not relieve Division 22
– Contractor from the obligations to complete all portions of work in a satisfactory and fully operational manner.

G. Refer to Division 01, Section 01 9113, for a full list of commissioning related definitions. A few critical definitions are included below:

1. *Commissioning*. A systematic process that provides documented confirmation that specific and interconnected fire and life safety systems function according to the intended design criteria set forth in the project documents and satisfy the owner's operational needs, including compliance requirements of any applicable laws, regulations, codes, and standards requiring fire and life safety systems.
2. *Commissioning Authority (CxA*). The qualified person, company, or agency that plans, coordinates, and oversees the entire Cx process.

3. *Commissioning Plan*. The document prepared for each project, which identifies the processes and procedures necessary for a successful Cx process.
4. *Commissioning Record*. The complete set of commissioning documentation for the project, which is turned over to the owner at the end of the construction phase.
5. *Functional Testing*. Tests performed to verify compliance with manufacturers' specifications, applicable codes and standards, and the project BOD and OPR.

1.4 RELATED SECTIONS

A. Division 01 Section 01 91 13 - General Commissioning Requirements

B. Division 21 Section 21 08 00 - Commissioning of Fire Suppression

C. Division 23 Section 23 08 00 - Commissioning of HVAC Systems

D. Division 25 Section 25 08 00 - Commissioning of Integrated Automation System

E. Division 26 Section 26 08 00 - Commissioning of Electrical Systems

F. Individual Division 01, 21, 22, 23, 25, and 26 sections contain requirements related to the commissioning process.

1.5 ROLES AND RESPONSIBILITIES

A. Refer to Section 01 91 13 for Commissioning Authority, Owner, Architect, and General Contractor roles and responsibilities.

B. Refer to Section 21 08 00 for fire suppression contractor roles and responsibilities.

C. Refer to Section 22 08 00 for plumbing contractor roles and responsibilities.

D. Refer to Section 23 08 00 for Mechanical contractor roles and responsibilities.

E. Refer to Section 25 08 00 for Integrated Automation System contractor roles and responsibilities.

F. Refer to Section 26 08 00 for Electrical contractor roles and responsibilities.

G. Design Team

1. Provide the Owners Project Requirements (OPR).
2. Provide documentation of initial design concepts and Design Intent based on Owner's program.

3. Provide plumbing system design parameters and obtain approval of Owner.
4. Prepare contract documents incorporating Commissioning Specification requirements and description of the electrical systems.
5. The Design Team shall specify and verify adequate maintenance accessibility for each piece of equipment in shop drawings and the actual installation.
6. Periodic inspections as part of the Design Team's contract with the Architect and/or Owner.
7. Review and approve submittals.
8. Participate in commissioning meetings.
9. Review Pre-functional Checklists and Functional Performance Test procedures submitted by the Commissioning Authority.
10. Prepare punch lists.
11. Review as-built records as required by contract documents. Issue a report noting deficiencies requiring correction to the Commissioning Authority.
12. Review and comment on final commissioning report.

H. Plumbing Contractor

1. Include cost to complete commissioning requirements for plumbing systems in the contract price.
2. Include requirements for submittal data, O&M data, and training in each purchase order or sub contract written.
3. Ensure cooperation and participation of all subcontractors.
4. Ensure participation of major equipment manufacturers in appropriate training and testing activities.
5. Attend Construction Phase coordination meeting scheduled by the Commissioning Authority.
6. Conduct plumbing system orientation and inspection when equipment is set.
7. Respond to (in writing) and address items documented in the Contractor Commissioning Issues Log.
8. Notify the GC a minimum of two weeks in advance of system start-up and testing, so CxA may be on site to witness.
9. Notify the GC a minimum of two weeks in advance, of the time for start of the TAB work. Attend the initial TAB meeting for review of the TAB procedures.
10. Submit copies of all test results to the CxA.
11. Complete Pre-Functional Checklists for all equipment.

    a. If no other system is agreed upon by Commissioning Team, Plumbing Contractor shall be responsible for completion of Pre-Functional Checklists for all equipment for which it issued a purchase order.
    b. Plumbing Contractor shall coordinate completion of Pre-Functional Checklists with all other contractors that have made connections to equipment for which it issued a purchase order.
    c. Remedy any deficiencies identified in Pre-Functional Checklists and notify CxA in writing that deficiencies have been addressed.

12. Assist the Commissioning Authority in all Pre-Functional Checklist verifications and Functional Performance Tests.
13. Prepare preliminary schedule for plumbing system orientation and inspections, O&M manual submission, training sessions, pipe system testing, flushing and cleaning, equipment start up, TAB, and task completion for use by the GC and Commissioning Authority. Update schedule as appropriate throughout the construction period.
14. Conduct plumbing system orientation and inspection when equipment is set in place.
15. Keep drawings updated as changes in the field are made, and review with the GC and Commissioning Authority.
16. Gather O&M data on all equipment, and assemble in binders as required by the Commissioning Specification. Submit to GC for review prior to the completion of construction.
17. Participate in, and schedule vendors and Contractors to participate in the training sessions as set up by the GC.
18. Provide written notification to the General Contractor and Commissioning Authority that the following work has been completed in accordance with the contract documents, and that the equipment, systems, and sub-systems are functioning as required.

    a. Domestic cold and hot water equipment and systems including all pumps, meters, backflow preventers, softeners, thermostatic mixing valves, and all Division 22 equipment.
    b. Specialty plumbing systems, medical gas systems and certification, if applicable.
    c. Storm water system.
    d. Building automation systems are functioning to relay plumbing and medical gas equipment alarms where required.

19. Submit training syllabus for approval to Commissioning Authority.
20. Participate in, and schedule vendors and Contractors to participate in the training sessions as set up by the GC. Provide site-specific training information on digital media/electronic format (flash drive, CD, DVD). If training is videotaped, provide on digital media/electronic format (flash drive, CD, DVD).
21. Provide a complete set of as-built records to the GC. Hard Copy and Electronic Format (Flash Drive, CD, DVD, etc….) are required.

I. Test, Adjust, and Balance Contractor

1. Include cost for commissioning requirements in the contract price.
2. Attend initial commissioning coordination meeting scheduled by the Commissioning Authority.
3. Submit the TAB procedures to the GC for review and acceptance.
4. Attend the TAB review meeting scheduled by the GC. Be prepared to discuss the procedures that shall be followed in testing, adjusting and balancing the plumbing

system.

5. Participate in training sessions as scheduled by the GC.
6. At the completion of the TAB work, and submittal of final TAB report, notify the Plumbing Contractor.
7. Participate in verification of the TAB report, which will consist of repeating any selected measurement contained in the TAB report where required by the Commissioning Authority for verification or diagnostic purposes.

J. Equipment Manufacturers and Miscellaneous Contractors

1. Include cost for commissioning requirements in the contract price.
2. Provide submittals, and appropriate O&M manual section(s).
3. Attend initial commissioning coordination meeting scheduled by the Commissioning Authority.
4. Participate in training sessions as scheduled by the GC.
5. Demonstrate performance of equipment as applicable

1.6 SCOPE OF WORK

A. Commissioning work of Division 22 shall include, but not be limited to:

1. Testing and start-up of the equipment.
2. Logging in and checking the WCxS at least once a week for outstanding items.
3. Completion of Pre-Functional Checklists on the WCxS.
4. Testing, adjusting and balancing of domestic hot water systems.
5. Cooperation with the Commissioning Authority.
6. Providing qualified personnel for participation in commissioning tests, including seasonal testing required after the initial testing.
7. Providing equipment, materials, and labor as necessary to correct construction and/or equipment deficiencies found during the Commissioning Process.
8. Providing operation and maintenance manuals and as-built drawings to the Commissioning Authority for verification.
9. Providing training and demonstrations for the systems specified in this Division.

B. The work included in the Commissioning Process involves a complete and thorough evaluation of the operation and performance of all components, systems, and sub-systems. The following equipment and systems shall be evaluated:

1. Low and high zone Domestic Water Heaters and associated recirculation pumps and mixing valves
2. Domestic Water Booster Pumps
3. Automatic Sprinkler System including the fire and jockey pumps
4. Sump Pumps and Elevator Pump
5. R/O or special water systems

6. Trap primers

C. System components which will not be functionally performance tested but will be included in the commissioning scope for conformance to the design documents, verification of specified Contractor testing, construction phase observation, and training verification shall include:

1. Medical Air Compressor, Vacuum Pump, and Manifolds
2. Medical Gas Outlets, Alarms, Zoning and Zone Valve Boxes (checking installation only, not med gas certification)

D. Timely and accurate documentation is essential for the Commissioning Process to be effective. Documentation required as part of the Commissioning Process shall include but not be limited to:

1. Commissioning Process Reports, which may include the following:
   a. Commissioning Field Reports
   b. Design Team Issues Log
   c. Contractor Commissioning Issues Log
   d. Meeting Minutes
2. Pre-start, and start-up procedures
3. Pre-Functional Checklists
4. Functional Performance Tests
5. Training agenda and materials
6. As-built records
7. Final commissioning report
8. Operation and maintenance (O&M) manuals

E. Detailed testing may be performed on all installed equipment and systems to ensure that operation and performance conform to contract documents. All tests shall be witnessed by the Commissioning Authority. The following testing is required as part of the Commissioning process:

1. Pre-Functional Checklists (PFC) are comprised of a full range of checks and tests to determine that all components, equipment, systems, and interfaces between systems operate in accordance with contract documents. Verification is completed by the Division 22, 23 and 26 contractors and documented using Pre-Functional Checklists.
2. Functional Performance Tests (FPT) shall determine if the plumbing system is operating in accordance with the design intent. This includes all operating modes, interlocks, control responses, and specific responses to abnormal or emergency conditions.

F. Comprehensive training of O&M personnel shall be performed by the Plumbing Contractor, and where appropriate, by other sub-contractors, and vendors prior to turnover of building to the owner. The training shall include classroom instruction, along with hands-on instruction on the installed equipment and systems

1.7 DOCUMENTATION

A. The Commissioning Authority shall oversee and maintain the development of the document process. The GC shall facilitate project documentation through the web-based commissioning software. The commissioning documentation shall include, but not be limited to, the following:

1. Commissioning Plan
2. Commissioning Schedule
3. Document Request Log
4. Commissioning RFIs
5. Commissioning Field Reports on the WCxS
6. Design Team Issues Log on the WCxS
7. Contractor Commissioning Issues Log on the WCxS
8. Pre-Functional Checklists on the WCxS
9. Functional Performance Tests on the WCxS
10. See 01 9113 for additional information on the commissioning documentation.

PART 2 -**PRODUCTS**

2.1 TEST EQUIPMENT

A. The appropriate Contractor(s) shall furnish all special tools and equipment required for testing during the commissioning process. A list of all tools and equipment to be used during commissioning shall be submitted to the Commissioning Authority for approval. The owner shall furnish necessary utilities for the Commissioning Process.

2.2 TEST EQUIPMENT – PROPRIETARY

A. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the Commissioning Process as needed. Proprietary test equipment (and software) shall become the property of the owner upon completion of the Commissioning Process.

PART 3 - **EXECUTION**

3.1 GENERAL

A. A pre-construction meeting of all Commissioning Team members shall be held at a time and place designated by the owner. The purpose shall be to familiarize all parties with the Commissioning Process, and to ensure that the responsibilities of each party are clearly understood.

B. The Contractor shall complete all phases of work so the systems can be started, tested, balanced, and commissioning procedures undertaken. This includes the complete installation of all equipment, materials, pipe, duct, wire, insulation, controls, etc., per the contract documents and related directives, clarifications, and change orders.

C. A Commissioning Plan shall be developed by the Commissioning Authority. The Contractor shall assist the Commissioning Authority in preparing the Commissioning Plan by providing all necessary information pertaining to the actual equipment and installation. If contractor-initiated system changes have been made that alter the Commissioning Process, the Commissioning Authority shall notify the Owner.

D. Acceptance procedures are normally intended to begin prior to completion of a system and/or sub-systems, and shall be coordinated with the Division 22 contractor. Start of acceptance procedures before system completion does not relieve the contractor from completing those systems as per the schedule.

3.2 PARTICIPATION IN COMMISSIONING

A. The Contractor shall provide skilled technicians to start-up and debug all systems within Division 22. These same technicians shall be made available to assist the Commissioning Authority in completing the commissioning program. Work schedules, time required for testing, etc., shall be requested by the Commissioning Authority and coordinated by the contractor. Contractor shall ensure that the qualified technician(s) are available and present during the agreed upon schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.

B. System performance problems and discrepancies may require additional technician time, Commissioning Authority time, reconstruction of systems, and/or replacement of system components. The additional technician time shall be made available for subsequent commissioning periods until the required system performance is obtained.

C. The Commissioning Authority reserves the right to question the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians shall include expert knowledge relative to the specific equipment involved and a willingness to work with the Commissioning Authority. Contractor shall provide adequate documentation and tools to start up and test the equipment, system, and/or sub-system.

3.3 DEFICIENCY RESOLUTION

A. In some systems, maladjustments, misapplied equipment, and/or deficient performance under varying loads will result in additional work being required to commission the systems. This work shall be completed under the direction of the Owner, with input from the contractor, equipment

manufacturer, and Commissioning Authority. Whereas all members shall have input and the opportunity to discuss, debate, and work out problems, the Owner shall make final determination over any additional required work to achieve performance.

B. Corrective work shall be completed in a timely fashion to permit the completion of the Commissioning Process. Experimentation to demonstrate system performance may be permitted. If the Commissioning Authority deems the experimentation work to be ineffective or untimely as it relates to the Commissioning Process, the Commissioning Authority shall notify the Owner, indicating the nature of the problem, expected steps to be taken, and suggested deadline(s) for completion of activities. If the deadline(s) pass without resolution of the problem, the Owner reserves the right to obtain supplementary services and/or equipment to resolve the problem. Costs incurred to solve the problems in an expeditious manner shall be the contractor's responsibility.

C. The Owner's contract with the Commissioning Authority includes up to two Functional Performance Tests of each piece of equipment or system included in the commissioning scope. Commissioning Authority time and expenses required for retests beyond two, if required, due to incomplete installation or otherwise, will be paid by the Owner and reimbursed by the contractor.

3.4 ADDITIONAL COMMISSIONING

A. Additional commissioning activities may be required after system adjustments, replacements, etc., are completed. The contractor(s), manufacturers, and Commissioning Authority shall include a reasonable reserve to complete this work as part of their contractual obligations.

3.5 CONSTRUCTION PHASE OBSERVATION

A. Scope of Construction Phase Observation

1. The Commissioning Authority will conduct periodic observations during the Construction Phase to monitor progress and compliance with the design intent and contract documents. It is the responsibility of the contractor to address the issues noted on the web-based commissioning application and notify Commissioning Authority of completion.
2. Commissioning Authority observations will coincide with Design Team observations and are not intended to take the place of this work.

B. Documentation and Reporting

1. Issues identified by the Commissioning Authority during Construction Phase will be documented using the web-based commissioning application and distributed to Commissioning Team members.
2. Progress during the Construction Phase will also be documented by the Commissioning Authority using Commissioning Process Reports.

3.6 ACCEPTANCE PROCEDURES

A. Pre-Functional Checklists

1. Pre-Functional Checklist Scope

a. Tests and verifications included in the Pre-Functional Checklists shall determine if all components, equipment, systems, and interfaces between systems are installed and are ready to operate in accordance with contract documents.

2. Pre-Functional Checklist Roles and Responsibilities

a. The Commissioning Authority shall be responsible for creating the Checklists, which will be completed by the installing contractors and then verified (via spot checking and Functional Performance Testing). Participating contractors, manufacturers, etc. shall include all costs to do the work involved in these tests in their proposals. The following is a list of tasks and supporting information that shall berequired:
b. The Plumbing Contractor shall provide the services of a technician(s) who is (are) familiar with the construction and operation of the applicable system. Provide access to the contract plans, shop drawings, and equipment cut sheets of all installed equipment.

3. Documentation and Reporting Requirements

a. Pre-Functional Checklists shall be provided for each component, piece of equipment, system, and sub-system, including all interfaces, interlocks, etc. Each item to be tested shall have a different entry line with space provided for comments. The checklists will include spaces for each party to sign off on.
b. Completed checklists shall be submitted to the Commissioning Authority for acceptance and inclusion in the commissioning report.

4. Acceptance of Pre-Functional Checklists

a. The Commissioning Authority will select, at random, 10 percent of the checklists for verification.
b. If 10 percent or more of the checklists are found to be inaccurate for each system or equipment type, all of the checklists for that system or equipment type will be rejected. Complete, accurate checklists will need to be resubmitted.

B. Test, Adjust, and Balance Verification

1. The Commissioning Authority shall select, at random, 10 percent of the report data for verification.
2. The TAB contractor shall be given sufficient advance notice of the date of field verification. However, they shall not be informed in advance of the data points to be verified.
3. Failure of an item is defined as:

    a. For all readings other than sound, a deviation of more than 10 percent.
    b. For sound pressure readings, a deviation of 3 decibels. (Note: variations in background noise must be considered).

4. A failure of more than 10 percent of the selected items shall result in the rejection of the final TAB report.

C. Functional Performance Testing

1. Scope of Functional Performance Testing

    a. Functional Performance Tests shall determine if equipment, system, and/or sub- system is operating in accordance with the final design intent. This includes all operating modes, interlocks, control responses, and specific responses to abnormal or emergency conditions. The following is a list of test examples:

        1) Determine capability of the sewage ejector to evacuate sewage at the required rate of flow.
        2) Determine capacity of domestic hot water system to deliver hot water at the design temperature.
        3) Determine the ability of the sump pumps to detect and properly react to all required alarms.

2. Functional Performance Test Report

    a. Detailed procedures for each series of tests will be developed by the Commissioning Authority for review and acceptance by the GC and Owner. The procedures shall include samples of the data sheets that will be part of the reports.

3. Participants in Functional Performance Tests

    a. Participants in the Functional Performance Tests shall be the same as those listed in the Pre-Functional Checklists.

4. Functional Performance Test Procedures

a. The Commissioning Authority shall supervise and direct all Functional Performance Tests.

1) Set the system equipment (i.e. water heater, pumps, ejectors, etc.) into the operating mode to be tested (i.e. normal shut-down, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
2) The Commissioning Authority shall inspect and verify the position of each device and interlock identified in the test procedure. Each item shall be signed off as acceptable (yes) or failed (no).
3) This test shall be repeated for each operating cycle that applies to the plumbing system being tested.
4) Operating checks shall include all safety cutouts, alarms, and interlocks with smoke control and life safety systems during all modes of operation of the plumbing system.
5) If during a test an operating deficiency is observed, appropriate comments will be added to the Test Procedure form and the Issues Log.
6) Confirmation of the TAB results shall be verified utilizing the Building Automation System. This shall include, but not be limited to, the following:

a) Verify domestic hot water recirculation balancing.

7) Verification of the proper responses of BAS system controllers and sensors shall be as follows:

a) For each controller or sensor, record the indicated BAS system reading, and the test instrument reading.
b) If the initial test indicates that the test reading is outside of the control range of the installed device, the calibration of the installed device shall be checked and adjusted as required. The deficient device shall be re- tested and the results recorded on the Functional Performance Test form.

b. If deficiencies are identified during Functional Performance Testing, the General Contractor will be notified, and action taken to remedy the deficiency. The final Functional Test Procedure forms will be reviewed by the Commissioning Authority to determine if testing is complete and the system is functioning in accordance with the contract documents.

5. Documentation and Reporting Requirements

a. All measured data, data sheets, and a comprehensive summary, describing the operation of the plumbing system at the time of testing shall be submitted to

the Commissioning Authority.

b. Data sheets used in verification of the proper operation of the control system shall include each controller to be verified, the system it serves, the service it provides, and its location. For each controller, provide space for recording the readout of the controller, the reading at the controller's sensor(s), and any comments.

c. A preliminary Functional Performance Test report shall be prepared by the Commissioning Authority and submitted to the Design Team for review. Any identified deficiencies need to be evaluated by the Design Team and General Contractor to determine if they are part of the contractor's or sub-contractor's contractual obligations. Construction deficiencies shall be corrected by the responsible contractor(s), and the specific Functional Performance Test repeated.

d. f it is determined that the plumbing system is constructed in accordance with the contract documents, and the performance deficiencies are not part of the contract documents, the Owner must decide whether any required modifications needed to bring the performance of the plumbing system up to the finalized design intent shall be implemented, or if the test shall be accepted as submitted. If corrective work is performed, the owner shall determine if a portion or all required Functional Performance Tests should be repeated, and a revised report submitted.

3.7 SYSTEMS MANUAL:

A. The Systems Manual shall be submitted in paper AND/OR electronic format and shall contain the following major sections:

1. System Descriptions:

a. Each major system shall be described, typewritten, in general terms, including major components, interconnections, theory of operation, theory of controls, unusual features and major safety precautions. This information should correlate with information provided in the manufacturers' instructions book. This section shall include, but not be limited to, the following data:

1) Detailed description of each system and each of its components showing piping, valves, controls, and other components, with diagrams and illustrations where applicable.
2) Wiring and control diagrams with data to explain detailed operation and control of each component.
3) Control sequences describing start-up, all modes of operation, and shut down.
4) Corrected shop drawings.
5) Approved product data including all performance curves and rating data.
6) Copies of approved certifications and laboratory or factory test reports

(where applicable).
7) Copies of warranties.

b. System diagrams, described in the following section, shall be incorporated in the appropriate systems descriptions. These should be reduced in size or folded to usefully fit into the manual.

2. Operating Instructions:

a. Condensed, typewritten, suitable for posting, instructions shall be provided for each major piece of equipment. Where more than one (1) common unit is installed, one instruction is adequate. The instructions shall provide procedures for:

1) Starting up the equipment/system
2) Shutting down the equipment/system
3) Operating the equipment in emergency or unusual conditions
4) Safety precautions
5) Trouble shooting suggestions
6) Other pertinent data applicable to the operation of particular systems or equipment

b. The instructions shall be suitable for posting adjacent to the equipment concerned.
c. The contractor shall provide instructions for (at minimum):

1) Booster Pumps
2) Circulating Pumps
3) Water softeners
4) Domestic hot water heaters
5) Thermostatic mixing valves
6) Sump pumps
7) Sewage ejector pumps

3. Ongoing and Preventive Maintenance:

a. Condensed, typewritten procedures for recommended ongoing and preventive maintenance actions shall be provided for each category of equipment/system listed above. This information shall include, but not be limited to the following:

1) Maintenance and overhaul instructions.
2) Lubricating schedule including type, grade, temperature, and frequency range.
3) Parts list, including source of supply and recommended spare parts.
4) Name, address, and 24 hour telephone number of each subcontractor who installed equipment and systems, and local representative for each

type of system.

5) Other pertinent data applicable to the maintenance of particular systems or equipment.

b. These recommended preventive maintenance actions shall be categorized by the following recommended frequencies:

1) Weekly
2) Monthly
3) Quarterly
4) Semi Annual
5) Annual
6) Other

B. Posted Operating Instructions and Diagrams:

1. Operating Instructions:

a. Copies of operating instructions provided in the Systems Manual shall be posted in the near vicinity of each piece of applicable equipment. The instructions shall be mounted neatly in frames under Plexiglas, where they can be easily read by operating personnel. Instructions mounted outdoors shall be suitably protected from weather.

3.8 SYSTEMS TRAINING:

A. The Plumbing Contractor, and appropriate sub-contractors, shall provide comprehensive systems instruction on building systems prior to delivery. The instruction shall include classroom instruction delivered by competent instructors based upon the contents of the Systems Manual. Emphasis shall be placed upon overall systems diagrams and descriptions, and how system components interact. The classroom instruction shall also include detailed equipment instruction by qualified manufacturer's representatives for which operating instructions are provided. The manufacturer's representative training shall emphasize operating instructions and preventive maintenance as described in the Systems Manual. At a minimum, the training sessions shall cover the following items:

1. Types of installed systems
2. Theory of operation

a. Design intent
b. Emergency conditions and procedures
c. Comfort conditions
d. Energy efficiency
e. Other issues important to facility operation

3. System operations
4. Use of control system

    a. Sequence of operation
    b. Problem indicators
    c. Diagnostics
    d. Corrective actions

5. Service, maintenance, diagnostics and repair
6. Use of reports and logs
7. Troubleshooting, investigation of malfunctions, and determining reasons for the problem

B. Each classroom training period shall be followed by an inspection, explanation, and demonstration of the system by the instructors. The applicable equipment shall be demonstrated including system startup and shutdown, with the exception of sprinkler systems.

C. The contractor shall be responsible for organizing, arranging, and delivering this instruction in an efficient and effective manner on a schedule agreeable to the Owner.

D. The contractor shall provide, at or before substantial completion, a proposed agenda and schedule of the above training for approval by the Commissioning Authority and the Owner

END OF SECTION

SECTION 221000 – PLUMBING EQUIPMENT

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
   1. Provide Payment and Performance Bonds for the full value of their Subcontract.
   2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
   1. Comply with the Instructions to Bidders.
   2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
   3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
   4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
      FILED SUBCONTRACTOR'S BID FOR SECTION:
      22 10 00 – PLUMBING EQUIPMENT

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
   1. All subcontractors to the Filed Subcontractor, whose work is:
      a. Valued at $10,000 or more.
   2. The contract sum for each subcontractor required to be listed.
      a. An affidavit that all subcontractors named on the Filed Subcontractor's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
   3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
   4. Comply with the applicable New York General Laws and the following:
      a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the

Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None.	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. P0.01 – Plumbing Schedules and Details
2. P0.02 – Plumbing Notes
3. P0.03 – SMT Rough-In Details
4. P0.04 – Sanitary Waste and Natural Gas Riser Diagrams
5. P1.01 – Sanitary Plan
6. P2.01 – Water Piping Plan
7. P3.01 – Natural Medical/Gas and Storm Drainage Plan
8. P3.02 – Roof Natural Gas and Storm Drainage Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 22 00 00 – Common Work Results for Plumbing
2. Section 22 05 13 – Common Motor Requirements for Plumbing Equipment
3. Section 22 05 16 – Expansion Fittings and Loops for Plumbing Piping
4. Section 22 05 17 – Sleeves and Sleeve Seals for Plumbing
5. Section 22 05 18 – Escutcheons for Plumbing Piping
6. Section 22 05 19 – Meter and Gauges for Plumbing
7. Section 22 05 23 – General Duty Valves for Plumbing Piping
8. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
9. Section 22 05 48 – Vibration Controls for Plumbing Piping and Equipment
10. Section 22 05 53 – Identification for Plumbing Piping and Equipment
11. Section 22 07 00 – Plumbing Insulation
12. Section 22 08 00 – Commissioning of Plumbing Systems
13. Section 22 10 00 – Plumbing Equipment
14. Section 22 11 18 – Domestic Water Distribution System
15. Section 22 11 19 – Plumbing Specialties
16. Section 22 13 16 – Sanitary Waste and Vent Piping
17. Section 22 13 19 – Sanitary Waste Piping Specialties
18. Section 22 31 00 – Domestic Water Softeners
19. Section 22 34 00 – Domestic Water Heaters
20. Section 22 40 00 – Plumbing Fixtures

B. Alternates: None.

1.3 SUMMARY

A. Section Includes:

1. Self-Priming Sewage and Sump Pumps - With Four Solid State Level Switches.
2. Self-Priming Sewage and Sump Pumps - With Dual Level Switches.
3. Domestic Water Booster Pump Systems - High Pressure (Above 100 psi).
4. Domestic Water Booster Pump Systems - Low Pressure (100 psi maximum).
5. Electric Water Coolers.
6. Duplex Sump Pumps Systems - Duplex - Submersible Vortex or Semi-Open - 2 Digital Level Switches.
7. Duplex Sump Pumps Systems - Submersible Vortex - 2 Digital Level Switches.

B. Related Sections:

1. Section 22 1118 “Domestic Water Distribution System.”

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, including dimensions, rough-in and connection requirements, and electrical data.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

B. Northwestern University Maintenance Requirement Forms, see division 01 for more information.

1.6 QUALITY ASSURANCE

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.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

C. Comply with requirements of NSF-61 and 372 as applicable to each type of pump system.

1.7 REFERENCE STANDARDS

A. The work in this section is subject to the requirements of applicable portions of the following standards:

1. HI - Hydraulic Institute
2. ANSI – American National Standards Institute
3. ASTM – American Society for Testing and Materials
4. IEEE – Institute of Electrical and Electronics Engineers
5. NEMA – National Electrical Manufacturers Association
6. NEC – National Electrical Code
7. UL – Underwriters Laboratories, Inc.
8. NSF - National Sanitation Foundation

PART 2 - PRODUCTS

2.1 SEWAGE EJECTOR AND SUMP PUMP SYSTEMS – DUPLEX – SELF-PRIMING - WITH FOUR SOLID STATE LEVEL SWITCHES, IF SPECIFIED

A. Provide self-priming sewage or sump pump systems, with four (4) digital level switches, of the sizes and capacities as noted on the drawings.

B. The pumps shall be duplex, self priming type designed for floor-level installation above the wet- well. The pumps shall be designed to facilitate pump maintenance and volute-cleaning above the wet-well, in a clean, dry and safe environment. Pump designs which require personnel to enter the confined-space of the wet-well for any reason, or lift equipment weighing many hundreds of pounds out of the wet-well for servicing, are not acceptable.

C. The pumping systems shall be as manufactured by Metropolitan Industries, of Romeoville, IL., and shall include two self priming sump pumps with close-coupled motors, mounted on an epoxy-coated steel basin cover provided with suction pipe openings, inspection-opening and suspension devices for the level controls.

D. The system shall be designed such that no equipment is installed below the basin-cover, other than the suction-pipes, vent-pipe, and four (4) solid-state level switches with stainless-steel mounting-chain & anchor, all of which shall be suspended from the cover.

E. Pump construction and design.

1. The pumps shall be capable of passing solids of the sizes indicated on the contract drawings. The impeller and removable volute lip-plate shall be constructed of ductile-iron. The complete pump rotating unit which includes the motor, motor mounting bracket, mechanical seal, replaceable volute-lip and impeller shall be removable as a one-piece unit, back-pull-out design, without disturbing the suction or discharge piping.
2. The impeller shall be of the enclosed type, with pump out vanes on both the front and the back shroud. The pump units shall include bronze case wear rings, and removable casing access covers, so that all parts of the pump suction-case, including the impeller port, shall be accessible for cleaning and inspection.

3. The pump casing shall be designed so that sufficient liquid is retained in the casing to re- prime the pump. The pump shall include an integral removable suction flap-valve, and shall be capable of re-prime, even if solids become lodged under suction flap-valve, causing liquid to drain back to the wet-well when the pump is idle.
4. The pump shall be provided with a vacuum-rated grooved-coupling, attached to the suction-elbow, for connection to the grooved-end suction pipe.

F. Close-coupled motor.

1. Each pump shall be driven by a NEMA Premium-Efficiency motor to keep pace with EISA protocols. The motors shall have a totally-enclosed fan-cooled (TEFC) enclosure with a1.15 service-factor. Each pump must operate within the nameplate horsepower of the motor at all points along the entire pump capacity head curve beyond the duty-point condition, reserving the available service factor of the motor as a safety-factor.
2. Performance curves which extend into the service (safety) factor, beyond the nameplate horsepower line at any point, are not acceptable.

G. Control panel.

1. Provide a single enclosure power and control panel (NEMA 1). The enclosure shall be steel, and finished with an oven baked enamel. The panel shall include a door-interlocked through-the-door safety disconnect switch. The control panel shall have the UL listing mark for industrial control panels, and shall include a microprocessor-based process- controller. Relay-based control systems, which do not allow the flexibility of being re- programmed in the field, are not acceptable.

    a. The internal portion of the control panel shall include one (1) 3-phase power-distribution block, two (2) 3-phase thermal magnetic circuit breakers, two (2) across the line starters, and two (2) adjustable class-10 overload-blocks. The enclosure shall also house all other necessary control components, including but not limited to one (1) control-circuit transformer with separately-fused primary, and secondary, microprocessor-based process-controller, as specifically referenced below.
    b. The process-controller shall include an on-board 24vac control-circuit transformer, to provide low-voltage power to the level-switches.
    c. The process-controller shall be designed with the following fail-safe operational features and indicators:

        1) If one, two, or as many as three of the four wet-well level-switches become inoperable, the fail-safe self-diagnostic logic controller shall be designed to continue uninterrupted automatic operation of one or both pumps, and all alarms & faults.

    d. The process-controller shall include the following indicators:

1) One (1) power-on light
2) Two (2) pump-run lights
3) Two (2) pump-fail lights
4) Two (2) contactor feedback status lights
5) Two (2) seal-fail lights (when applicable)
6) Four (4) level-switch status lights
7) One (1) alarm code light to display seven (7) flashing fault codes
8) One (1) flashing high wet-well level alarm light

e. The control panel shall include the following devices, for use in remotely monitoring the system:

1) Two (2) sets: pump seal-fail digital dry alarm contacts (when applicable).
2) One (1) set: high wet-well level digital dry alarm contacts.

f. The process-controller shall perform the following major functions:

1) Start and stop 1-pump during normal flow conditions.
2) Start and stop 2-pumps during extreme flow conditions.
3) Alternate two pumps on successive cycles of operation.
4) Monitor & delay pump-starts to avoid short-cycling motors.
5) Monitor & delay pump-starts to avoid simultaneous starting of pumps following utility power losses.
6) Monitor & recognize inoperable level-switches, and modify system operation to compensate for this occurrence.
7) Provide easily identifiable alarm codes for the operating personnel to monitor.
8) Include separate fuses for each contactor circuit, as well as each alarm circuit.
9) Monitor embedded pump-motor thermal-sensors, when wired.

2. The control system shall be provided with a Metropolitan “Metro-Mail”, messaging system, designed to monitor and report the status of the equipment to key personnel, during regular and/or emergency situations. The unit shall be capable of sending e-mail messages or text messages through an internet connection. The equipment control system shall include singular or multiple remote alarm contacts as designated within the equipment control system specifications. These shall be factory pre-wired to the Metro- Mail messaging system, each powered by a 10-to-30 volt ac-or-dc power supply. The messaging system shall include eight (8) electrically-separated, optically-isolated digital inputs. Each pair of input terminals shall include a red led-indicator light, which shall illuminate when the circuit is energized. The messaging system shall also include a single led-indicator status-light. This light shall glow-green to indicate that the unit is powered and is properly configured; and shall flash to indicate that an e-mail is being transmitted. The led-indicator shall glow-amber to indicate that the unit is booting, or to indicate that an ip-number has not

been assigned. An ethernet port shall be provided, to allow connection of the unit to an internet connection, using a standard or crossover ethernet cable. The Metro-Mail shall include an on-board web-server, allowing the user to configure messages; e-mail addresses; and other settings, via a standard web browser. The Metro-Mail shall be powered through the main equipment control system, via a 10-to- 30 vac/dc power supply.

3. Control systems without all of the essential fail-safe operational features, lights, fault-codes, indicators, and remote-monitoring devices listed above are insufficient for the intended service, and are not acceptable.
4. Provide BAS options on panel or extra connection points for future BAS connection. Confirm requirements with NU.

H. Liquid level sensors.

1. Provide four (4) suspended solid-state digital level-switches, of the strain-gauge type, designed with no moving parts. Mechanically operated switches, which are more susceptible to failure, are not acceptable. Cord grips fastened to the basin-cover shall be used to support the level-switch cords. The switches shall be fastened to a stainless-steel chain with anchor, in such a way that allows level-adjustment of the switches from above the basin cover. These level-switches shall be used to control & monitor liquid level in the wet-well.
2. The switch installed in the lowest position shall shut off all pumps. The next switch from the bottom will start one pump and shall trigger alternation of the pumps on each successive cycle of operation. The third switch from the bottom shall start both pumps or start the second pump if the first pump fails for any reason.
3. The fourth switch shall be located at the highest point, at the invert of the basin inlet, and shall signal a high wet-well level alarm. All level-switches shall be removable through the basin cover.

I. Field installation requirements.

1. A suction pipe shall be provided by the contractor and installed on each pump. The suction pipe must be of 1-piece construction, and shall be schedule-80 PVC, galvanized steel, or iron pipe. The size of the pipe shall be the same size as the pump suction connection. The suction pipes shall be installed air tight. The bottom end of the pipe shall be installed to a point measuring 6"-to-8” from the wet well floor.
2. An appropriate sewage-type check-valve shall be provided by the contractor and shall be installed in the discharge line of each pump. An appropriate gate-valve or plug-valve shall be provided by the contractor and shall be installed downstream of the check-valve.
3. A small diameter air vent line & isolation-valve shall be provided by the contractor & installed on each pump, per the manufacturer’s instructions. It shall be designed to evacuate any air on the discharge side of the pump-impeller, between the pump discharge nozzle and the discharge check valve. The outlet of the air vent line shall discharge into the wet well through the basin-cover. The line shall extend from the

basin- cover, down into the wet-well, and must terminate below the liquid-level, but no lower than a point 6”-to-8” above the bottom of the suction pipe.

J. Qualification Of Equipment Manufacturer:

1. In order to establish a standard of quality and to insure a uniform basis of bidding, the system shall be manufactured by Metropolitan Industries, Inc., or a prior written approval equal, approved by FMDC and FMO plumbing staff. To be considered an approved equal, complete details and shop drawings must be submitted to the engineer no later than ten (10) days prior to the bid date. Sufficient data must be submitted so that the engineer has the required information available to determine whether the alternate system meets the requirements of the specifications. The contractor shall prepare his bid on the basis of the specific system specified for purposed of determining the low bid. After the execution of the contract, substitution of non-specified equipment will be considered, if the substitution is, in the opinion of the engineer, equal in quality, substance, and performance to the named manufacturer. If such substitution is approved by the engineer, all savings affected by the contractor in the purchase of the substituted equipment shall be passed on to the owner by reducing the contract price. In submitting for substitution, the contractor shall provide certified copies of equipment proposals from the named manufacturer, as well as the substitute manufacturer.
2. The equipment manufacturer shall furnish 24 hour service for the complete system, and shall stock all integration parts used for the installation.

K. Start Up Service:

1. The service of a factory trained representative shall be made available on the jobsite for one (1) six-hour period of time, to verify proper installation of the system, provide start up, and adjustment, and provide instructional operational training for the operator’s personnel.

2.2 SEWAGE EJECTOR AND SUMP PUMP SYSTEMS – DUPLEX – SELF-PRIMING - WITH DUAL LEVEL SWITCH ASSEMBLY FLOATS, IF SPECIFIED

A. Provide self-priming sewage or sump pump systems, with pedestal-mounted mechanical-alternator level switch assembly, of the sizes and capacities as noted on the drawings.

B. The pumps shall be duplex, self-priming type designed for floor-level installation above the wet- well. The pumps shall be designed to facilitate pump maintenance and volute-cleaning above the wet-well, in a clean, dry and safe environment. Pump designs which require personnel to enter the confined-space of the wet-well for any reason, or lift equipment weighing many hundreds of pounds out of the wet-well for servicing, are not acceptable.

C. The pumping systems shall be as manufactured by Metropolitan Industries, of Romeoville, IL., and shall include two self-priming sump pumps with close-coupled motors, mounted on an epoxy-coated steel basin cover provided with suction pipe openings, inspection-opening and suspension devices for the level controls.

D. The system shall be designed such that no equipment is installed below the basin-cover, other than the suction-pipes, vent-pipe, and two (2) level switch assembly floats, all of which shall be suspended from the cover.

E. Pump construction and design.

1. The pumps shall be capable of passing solids of the sizes indicated on the contract drawings. The impeller and removable volute lip-plate shall be constructed of ductile-iron. The complete pump rotating unit which includes the motor, motor mounting bracket, mechanical seal, replaceable volute-lip and impeller shall be removable as a one-piece unit, back-pull-out design, without disturbing the suction or discharge piping.
2. The impeller shall be of the enclosed type, with pump-out vanes on both the front and the back shroud. The pump units shall include bronze case wear rings, and removable casing access covers, so that all parts of the pump suction-case, including the impeller port, shall be accessible for cleaning and inspection.
3. The pump casing shall be designed so that sufficient liquid is retained in the casing to re- prime the pump. The pump shall include an integral removable suction flap-valve, and shall be capable of re-prime, even if solids become lodged under suction flap-valve, causing liquid to drain back to the wet-well when the pump is idle.
4. The pump shall be provided with a vacuum-rated grooved-coupling, attached to the suction-elbow, for connection to the grooved-end suction pipe.

F. Close-coupled motor.

1. Each pump shall be driven by a NEMA Premium-Efficiency motor to keep pace with EISA protocols. The motors shall have a totally-enclosed fan-cooled (TEFC) enclosure with a

1.15 service-factor. Each pump must operate within the nameplate horsepower of the motor at all points along the entire pump capacity-head curve beyond the duty-point condition, reserving the available service factor of the motor as a safety-factor.

2. Performance curves which extend into the service (safety) factor, beyond the nameplate horsepower line at any point, are not acceptable.

G. Control Panel

1. Provide a single enclosure power and control panel (NEMA 1). The enclosure shall be steel, and finished with an oven-baked enamel. The panel shall include a door-interlocked through-the-door safety disconnect switch. The control panel shall have the UL listing mark for industrial control panels, and shall include a microprocessor-

based process-controller. Relay-based control systems, which do not allow the flexibility of being re-programmed in the field, are not acceptable.

a. The internal portion of the control panel shall include one (1) 3-phase power- distribution block, two (2) 3-phase thermal magnetic circuit breakers, two (2) across the line starters, and two (2) adjustable class-10 overload-blocks. The enclosure shall also house all other necessary control components, including but not limited to one (1) control-circuit transformer with separately-fused primary, and secondary, microprocessor-based process-controller, as specifically referenced below.

b. The process-controller shall include an on-board 24vac control-circuit transformer, to provide low-voltage power to the level-switches.

c. The process-controller shall be designed with the following fail-safe operational features and indicators:

1) If the mechanical float alternator becomes inoperable, the fail-safe self-diagnostic logic controller shall be designed to continue uninterrupted automatic operation of one or both pumps, and all alarms & faults.

d. The process-controller shall include the following indicators:

1) One (1) power-on light
2) Two (2) pump-run lights
3) Two (2) pump-fail lights
4) Two (2) contactor feedback status lights
5) Two (2) seal-fail lights (when applicable)
6) Four (4) level-switch status lights
7) One (1) alarm light to display three (3) flashing fault codes
8) One (1) flashing high wet-well level alarm light

e. The control panel shall include the following devices, for use in remotely monitoring the system:

1) Two (2) sets: pump seal-fail digital dry alarm contacts (when applicable).
2) One (1) set: high wet-well level digital dry alarm contacts.

f. The process-controller shall perform the following major functions:

1) Start and stop 1-pump during normal flow conditions.
2) Start and stop 2-pumps during extreme flow conditions.
3) Alternate two pumps on successive cycles of operation.
4) Monitor & delay pump-starts to avoid short-cycling motors.
5) Monitor & delay pump-starts to avoid simultaneous starting of pumps following utility power losses.
6) Monitor & recognize inoperable level-switches, and modify system

operation to compensate for this occurrence.

7) Provide easily identifiable alarm codes for the operating personnel to monitor.
8) Include separate fuses for each contactor circuit, as well as each alarm circuit.
9) Monitor embedded pump-motor thermal-sensors, when wired.

2. The control system shall be provided with a Metropolitan "Metro-Mail", messaging system, designed to monitor and report the status of the equipment to key personnel, during regular and/or emergency situations. The unit shall be capable of sending e-mail messages or text messages through an internet connection. The equipment control system shall include singular or multiple remote alarm contacts as designated within the equipment control system specifications. These shall be factory pre-wired to the Metro- Mail messaging system, each powered by a 10-to-30 volt ac-or-dc power supply. The messaging system shall include eight (8) electrically-separated, optically-isolated digital inputs. Each pair of input terminals shall include a red led-indicator light, which shall illuminate when the circuit is energized. The messaging system shall also include a single led-indicator status-light. This light shall glow-green to indicate that the unit is powered and is properly configured; and shall flash to indicate that an e-mail is being transmitted. The led-indicator shall glow-amber to indicate that the unit is booting, or to indicate that an ip-number has not been assigned. An ethernet port shall be provided, to allow connection of the unit to an internet connection, using a standard or crossover ethernet cable. The Metro-Mail shall include an on-board web-server, allowing the user to configure messages; e-mail addresses; and other settings, via a standard web browser. The Metro-Mail shall be powered through the main equipment control system, via a 10-to- 30 vac/dc power supply.

3. Control systems without all of the essential fail-safe operational features, lights, fault-codes, indicators, and remote-monitoring devices listed above are insufficient for the intended service, and are not acceptable.
4. Provide BAS options on panel or extra connection points for future BAS connection. Confirm requirements with NU.

H. Liquid level sensors.

1. Provide one (1) pedestal-mounted mechanical float-alternator assembly with stainless steel float-ball, float-rod, and rod-stops, as well as one (1) suspended mechanical alarm level-switch, which shall be used to control & monitor liquid level in the wet-well. The level-switches shall be installed in such a way that they allow level-adjustment of the switches from above the basin cover.
2. The mechanical alternator switch indexed in the lowest position shall shut-off all pumps. The next-highest indexed position shall start one pump, and shall trigger alternation of the pumps on each successive cycle of operation. The third and highest indexed position shall start both pumps or start the second pump if the first pump fails for any reason.

3. The suspended mechanical alarm level-switch shall be located at the highest elevation of all wet-well inlet elevations, and shall signal a high wet-well level alarm. All level-switches shall be removable through the basin cover.

I. Field installation requirements.

1. A suction pipe shall be provided by the contractor and installed on each pump. The suction pipe must be of 1-piece construction, and shall be schedule-80 PVC, galvanized steel, or iron pipe. The size of the pipe shall be the same size as the pump suction connection. The suction pipes shall be installed air tight. The bottom end of the pipe shall be installed to a point measuring 6"-to-8" from the wet-well floor.
2. An appropriate sewage-type check-valve shall be provided by the contractor and shall be installed in the discharge line of each pump. An appropriate gate-valve or plug-valve shall be provided by the contractor and shall be installed downstream of the check-valve.
3. A small diameter air vent line & isolation-valve shall be provided by the contractor & installed on each pump, per the manufacturer's instructions. It shall be designed to evacuate any air on the discharge side of the pump-impeller, between the pump discharge nozzle and the discharge check valve. The outlet of the air vent line shall discharge into the wet-well through the basin-cover. The line shall extend from the basin- cover, down into the wet-well, and must terminate below the liquid-level, but no lower than a point 6"-to-8" above the bottom of the suction pipe.

J. Qualification Of Equipment Manufacturer:

1. In order to establish a standard of quality and to insure a uniform basis of bidding, the system shall be manufactured by Metropolitan Industries, Inc., or a prior written approval equal, approved by FMDC and FMO plumbing staff. To be considered an approved equal, complete details and shop drawings must be submitted to the engineer no later than ten (10) days prior to the bid date. Sufficient data must be submitted so that the engineer has the required information available to determine whether the alternate system meets the requirements of the specifications. The contractor shall prepare his bid on the basis of the specific system specified for purposed of determining the low bid. After the execution of the contract, substitution of non-specified equipment will be considered, if the substitution is, in the opinion of the engineer, equal in quality, substance, and performance to the named manufacturer. If such substitution is approved by the engineer, all savings affected by the contractor in the purchase of the substituted equipment shall be passed on to the owner by reducing the contract price. In submitting for substitution, the contractor shall provide certified copies of equipment proposals from the named manufacturer, as well as the substitute manufacturer.
2. The equipment manufacturer shall furnish 24 hour service for the complete system, and shall stock all integration parts used for the installation.

K. Start-Up Service:

1. The service of a factory-trained representative shall be made available on the jobsite for one (1) six-hour period of time, to verify proper installation of the system, provide start-up, and adjustment, and provide instructional operational training for the operator's personnel.

2.3 DOMESTIC COLD WATER PRESSURE BOOSTER PUMPING SYSTEM - HIGH PRESSURE (ABOVE 100 PSI), IF SPECIFIED

A. Furnish and install a factory prefabricated multi-pump water pressure booster system with a separate hydro-pneumatic tank. System shall be of size and capacity as indicated on the Drawings. All wetted components of the system shall be constructed in strict compliance with ANSI/NSF-372, for low-lead content. System shall automatically provide complete pump shutdown during low-flow conditions while maintaining system pressure.

B. Pumps & Safety-Devices:

1. Pumps units shall be multi-stage centrifugal diffuser-type, of cast iron stainless-fitted construction, with one-piece replaceable stack-kits, and cartridge-type mechanical-seal.
2. The system shall have a separate pre-wired temperature probe and approved electrical purge valve, as well as an automatic pressure-relief valve, installed immediately downstream of each individual pump discharge nozzle.
3. Due to the potentially high outlet pressure of these safety-devices, each device shall each be piped to a common factory pre-fabricated 2" diameter drainage-header running the length of the structure, designed to dissipate the pressure energy prior to gravity drainage. Piping from the drainage-header to a waste opening shall be installed by the contractor in the field.

C. Motors:

1. Each pump shall be driven by a 3-Phase, 60 Hertz, open-drip-proof (ODP) motor. The motor shall have a synchronous speed of 3500 RPM, but shall operate at varying rates of speed during system operation. Each pump shall be driven by a NEMA Premium-Efficiency motor to keep pace with EISA protocols. Each pump must operate within the nameplate horsepower of the motor at all points along the entire pump capacity-head curve beyond the duty-point condition, reserving the available service factor of the motor as a safety-factor.

2. Pumps with performance curves which operate into the service (safety) factor, beyond the nameplate horsepower at any point, are not acceptable.

D. Hydro-Pneumatic Tank:

1. The following shall apply to all hydro-pneumatic tanks required by the pump-schedule. Furnish and install as shown on plans a pre-charged hydro-pneumatic tank or tanks. The tank shall be rated for a working pressure of 125-PSI minimum and a working temperature of 120°F minimum. All internal wetted parts must comply with FDA regulations and approvals. The tank shall be sized as scheduled.
2. The hydro-pneumatic tank shall include a replaceable flexible membrane, designed to separate the air and water. The flexible membrane shall contain the appropriate air-charge required to allow maximum water storage. A Schrader valve shall be located at the uppermost portion of the vessel, with a protective access cover. The tank shell shall be of composite material, comprised of filament-wound fiberglass, of sufficient wall thickness to contain water & air in combination, to a maximum working-pressure of 125- PSI. The unit shall have a stainless steel threaded or flanged elbow fitting, located at the lowermost portion of the tank, to allow maximum draw-down of the stored water. The fitting shall include a diffuser, designed to enhance water flow in & out of the vessel. The tank shall be manufactured entirely of corrosion-resistant materials. Fabricated steel vessels, which are susceptible to corrosion, are not acceptable.
3. The vessel shall be installed with isolation-valves in such a way as to allow the unit to be drained for maintenance purposes, without the need to drain the pressurized pump discharge line, or cause the operation of the pump system to be interrupted.
4. The pump control system shall include a 'sleep-mode' feature, which shall increase the set-point water pressure slightly during low-flow/no-flow situations, and increase the stored water pressure within the tank, in order to stop all pumps until increased flow- demand within the facility resumes.
5. The tank shall be installed at the appropriate elevation required in order to ensure that the maximum potential operating pressure does not exceed the rated maximum working pressure of the tank. The maximum potential operating pressure shall be considered to be the sum of the zero-flow shut-off head of the pump at full-speed, plus the maximum potential suction pressure at the system suction-header.

E. Power and Control System:

1. Furnish a single or multiple enclosure power and control system in NEMA-1 enclosures. The pumping system set-point pressure shall be accurately regulated by the control system. The control system shall include an individual variable frequency drive (VFD) for each pump on the system, which shall adjust the kilowatt power delivered and used by the pump motors, as required to match the system flow demand requirement at any given time, while maintaining the set-point pressure of the system. The operating speed and kilowatt input to the pump motors shall be reduced to the minimum necessary to satisfy the flow demand, and to reduce mechanical wear of the equipment. The control system efficiency shall be maintained at 94 percent, and the system power factor shall be .95 at all times. The VFD shall always soft-start the pump motors in order to reduce momentary power demands, as well as to eliminate mechanical and hydraulic shock to the system and the facility.
2. The control system shall operate each pump independently and in-unison in order to

maintain the system operating pressure set-point, as programmed by the operating engineer. Each of the pumps shall have its own VFD inverter.

3. A microprocessor based programmable logic controller (PLC) shall be furnished to process all of the operational input and output signals, including but not limited to, pressure set-points, operator selector settings, indicator lights and displays, and all alarmconditions. The logic program shall be factory installed and tested within the system and shall have provisions for field reprogramming through the use of a portable computer.

F. Pressure Transducers:

1. A system-pressure transducer shall be installed on the discharge-header of the pumping system.
2. A suction-pressure transducer shall be installed on the suction-header of the pumping system.
3. At the discretion of the University, compliance with the ruling of the U. S. Department of Energy imposing compliance with ANSI/ASHRAE Standard 90.1-2010 Addendum-CV may be required. In such cases, as indicated on the plan drawings, a third remotely-located pressure transducer shall be provided for installation at the furthermost point of the facility, designed to reduce the kilowatt requirement of the facility, by eliminating the calculated-friction-losses during low-to-medium flow periods. This transducer shall be the primary unit, and shall be utilized by the PLC to operate the system, in order to maintain the desired remote-pressure set-point.

   a. Fail-Safe Operation: The transducer mounted on the pump system discharge shall be the secondary transducer, and shall be a fail-safe unit, programmed to maintain system pressure, if the primary remote transducer should become inoperable.

G. System Operation:

1. System pressure and all other operating parameters shall be manually set by means of an operator interface screen on the face of the control system, as described herein. The proportional output signal from the pressure controller shall operate with internally set reset and rate response when following a pressure deviation that is within the adjusted proportional band. When pressure deviates from the set point in proportion greater than the internally adjusted proportional band, the controller shall control rapidly by bypassing rate in order to follow the rapidly changing pressure. The pressure controller shall maintain the variable speed proportional band for each pump.
2. The lead pump shall operate at varying rates of speed as required to maintain the desired system pressure. If a slight reduction of system pressure should occur when one pump is operating at the maximum programmed speed, a lag pump or multiple pumps, each as sequenced by system demand, shall accelerate and operate in-unison, to maintain stable system pressure during widely-varying flow-rate scenarios. After an

adjustable period of time, the lag pump or pumps each as sequenced by demand, shall decelerate and turn off. The lead pump designation shall alternate among all pumps on the system, every 23 hours.

3. Operator adjustment options shall be provided for multiple alarm conditions.

    a. Low suction pressure alarm indication and automatic shut-down. A low suction pressure condition will shut down the system until adequate suction pressure is restored.
    b. Low system pressure alarm indication. A low system pressure condition that is not satisfied by a pump within 30 seconds will signal an alarm.
    c. High system pressure alarm indication and automatic shut-down.

4. The system shall operate completely unattended, and shall have digital dry contact terminals for connection to the facility monitoring equipment.
5. At the discretion of the University, one (1) of the following monitoring systems may be required:

    a. Internet-Based Messaging-System: The control system shall be provided with a Metropolitan "Metro-Mail", messaging system, designed to monitor and report the status of the equipment to key personnel, during regular and/or emergency situations. The unit shall be capable of sending e-mail messages or text messages through an internet connection. The equipment control system shall include singular or multiple remote alarm contacts as designated within the equipment control system specifications. These shall be factory pre-wired to the Metro-Mail messaging system, each powered by a 10-to-30 volt ac-or-dc power supply. The messaging system shall include eight (8) electrically-separated, optically-isolated digital inputs. Each pair of input terminals shall include a red led-indicator light, which shall illuminate when the circuit is energized. The messaging system shall also include a single led-indicator status-light. This light shall glow-green to indicate that the unit is powered and is properly configured; and shall flash to indicate that an e-mail is being transmitted. The led-indicator shall glow-amber to indicate that the unit is booting, or to indicate that an ip-number has not been assigned. An ethernet port shall be provided, to allow connection of the unit to an internet connection, using a standard or crossover ethernet cable. The Metro-Mail shall include an on-board web-server, allowing the user to configure messages; e-mail addresses; and other settings, via a standard web browser. The Metro-Mail shall be powered through the main equipment control system, via a 10-to-30 vac/dc power supply.
    b. BACNet Communications Module: The control system programmable logic controller (PLC) shall be provided with a BACNet compliant or serial interface, allowing 2-way communication with the building automation network, using BACNet protocol. The module shall support 2-channel data communication: One channel shall be configured for RS-485 half-duplex serial communications; and the other channel shall be configured for 10/100M Ethernet full-duplex.

The data shall be stored on-board within the module.

H. The operator devices and indicators shall include:

1. A main power safety-disconnect for entire system.
2. A circuit breaker or fused safety-disconnect for each VFD.
3. A manual-off-automatic selection, for each pump.
4. A pump-running indication, for each pump.
5. A manual speed control - each pump.
6. A color touch-surface operator interface screen, to monitor and adjust all system parameters.

I. The color touch-surface operator interface panel shall incorporate the following design criteria & capabilities:

1. Incorporate a 5.6" Diagonal touch-surface, with a resolution of 320 x 234-Pixels, and Flash ROM of 4MB.
2. Capable of displaying a minimum of 65,500-colors.
3. Include an LCD display.
4. Include an LED backlight.
5. Incorporate one (1) USB Host version 1.1/1
6. Provide three (3) serial COM ports.
7. Include built-in perpetual calendar.
8. Have an operating voltage of 24Vdc.
9. Include a 3V lithium battery back-up power supply.

J. The operator interface panel shall provide trending screens, with multiple historical events:

1. Alarm event-logs, for all alarm conditions.
2. Discharge-pressure history.
3. Suction-pressure history.
4. VFD percent-speed – each VFD

K. Pump Sequencing

1. On-off sequencing shall be processed using the primary pressure signal, to enable 'sleep-mode' operation, and lead/lag pump operation. During typical daily operation, the pump sequencing at the programmed design conditions shall occur approximately as scheduled below:

(Select only one)

Duplex (2-Pump) System:

Pump #l shall operate only	0% - 60% of peak demand
Pump #1 and #2 shall both operate	61% - 120% of peak

demand

Triplex (3-Pump) System:

Pump #l shall operate only	0% - 40% of peak
demand Pump #1 and #2 shall both operate	41% - 80% of peak
demand Pump #1, #2 and #3 shall all operate demand	81% - l20% of peak

Quadraplex (4-Pump) System:

Pump #l shall operate only	0% - 30% of peak
demand Pump #1 and #2 shall both operate demand	31% - 60% of peak
Pump #1, #2 and #3 shall all operate	61% - 90% of peak demand
Pump #1, #2 #3 and #4 shall all operate	91% - 120% of peak demand

Pentaplex (5-Pump) System:

Pump #l shall operate only	0% - 25% of peak
demand Pump #1 and #2 shall both operate demand	26% - 50% of peak
Pump #1, #2 and #3 shall all operate	51% - 75% of peak demand
Pump #1, #2 #3 and #4 shall all operate	76% - 100% of peak demand
Pump #1, #2 #3 #4 and #5 shall all operate	101% - 125% of peak demand

2. In order to eliminate short-cycling of the motors, the on-off pump sequencing shall be automatically restricted to a maximum of six cycles per hour, per pump, under the actual real-time load conditions.

L. Non-electronic Instrumentation:

1. The system shall include multiple individual pressure gauges; one for each pump, as well as one for indication of the total-system discharge pressure, and one for the system suction pressure. Stainless-steel or copper tubing, with isolation-valves, shall be installed between the connection-point and the gauge-location: The pressure-gauges shall be liquid-filled, and shall be mounted adjacent to one another on the control system front- panel. Each pressure gauge shall be clearly labeled with the appropriate connection- point.

M. Factory Prefabrication:

1. The entire water pressure booster system shall be factory prefabricated on a common structural steel frame & base assembly with all interconnecting piping and wiring completed and operationally tested prior to shipment. The only field connections

required will be system suction and discharge headers, the drainage-header, and main power supply connection at the control panel. The remotely-located pressure transducer must by piped and wired by the contractors as well, when required by the contract.

2. The system shall include individual suction & discharge branch piping for each pump as well as common suction & discharge headers for the entire system. The piping & headers shall be fabricated of welded steel. The steel fabrications shall then be powder-coated with NSF-61 approved Scotchkote-134 fusion-bonded epoxy after all welding is complete, to ensure maximum corrosion-resistance.
3. A full-port threaded or flanged ball-valve or lug-type butterfly isolation valve shall be installed on the suction & discharge side of each pump, and each major component.
4. A threaded, flanged, or lug-type silent check valve shall be installed on the discharge side of each pump, between the pump & associated isolation valve. Projects within the city of Chicago shall also include a silent check valve on the suction side of each pump.
5. The piping, fittings, valves, and associated devices shall be pressure-rated as required to ensure that the maximum potential operating pressure of the system does not exceed the rated maximum working pressure of the components. The maximum potential operating pressure of the system shall be considered to be the sum of the zero-flow shut-off head of any pump at full-speed, plus the maximum potential suction pressure at the suction- header.
6. All piping, headers, valves, and associated devices shall be fully supported by the system's structural steel frame & base assembly. Support of the piping, headers, etc., by field-installed devices is not acceptable.
7. The diameter of the piping, valves, and headers shall be sized to minimize the full-flow velocity, as required to meet local code requirements, or engineer-approved acceptable velocity levels. When local code requirements are unclear, velocities may not exceed single-digit levels, as measured in feet-per-second, at full-flow.
8. When a remotely-located pressure transducer is required by the contract, it shall be plumbed in place along with a liquid-filled pressure-gauge, in the piping provided by the plumbing contractor, in the remote location indicated. The instrumentation contractor shall provide, route, and install the signal-cable from the transducer's remotely installed location, and shall terminate the cable in the water pressure booster system control panel.

N. Factory Test and Certification:

1. The fully-assembled system shall be factory flow-tested in the manufacturer's test-lab before shipment, to ensure correct operation. All of the specified functional & performance requirements are essential to project economics and are therefore subject to performance verification. Equipment that is found to be deficient with respect to these requirements shall not be accepted and shall be replaced at the contractor's expense with equipment that can meet these requirements. The flow-test shall be performed & certified in writing by a registered professional engineer (P. E.), at the expense of the manufacturer. The plumbing design engineer shall be

provided the opportunity of a factory inspection and witness-testing of the system prior to shipment from the manufacturing plant, (not the distributor's facility), to ensure quality and specification- compliance. All costs associated with the inspection & witness-testing, including travel- expenses & lodging-expenses, shall be included in the manufacturer's price. Test shall include a system operating flow test from zero to 120% design flow rate under specified suction and net delivery pressure conditions.

2. Certification shall be provided to the plumbing design engineer for approval. Prior to shipment of the system from the factory. The certification must be approved in writing by the plumbing design engineer. The certification shall include copies of the test data as recorded by X-Y plotter, certified in writing by the registered professional engineer (P. E.) performing and witnessing the test.

O. Qualification Of Equipment Manufacturer:

1. In order to establish a standard of quality and to insure a uniform basis of bidding, the system shall be manufactured by Metropolitan Industries, Inc., or a prior written approval equal, approved by FMDC and FMO plumbing staff. To be considered an approved equal, complete details and shop drawings must be submitted to the engineer no later than ten (10) days prior to the bid date. Sufficient data must be submitted so that the engineer has the required information available to determine whether the alternate system meets the requirements of the specifications. The contractor shall prepare his bid on the basis of the specific system specified for purposed of determining the low bid. After the execution of the contract, substitution of non-specified equipment will be considered, if the substitution is, in the opinion of the engineer, equal in quality, substance, and performance to the named manufacturer. If such substitution is approved by the engineer, all savings affected by the contractor in the purchase of the substituted equipment shall be passed on to the owner by reducing the contract price. In submitting for substitution, the contractor shall provide certified copies of equipment proposals from the named manufacturer, as well as the substitute manufacturer.
2. The equipment manufacturer shall furnish 24 hour service for the complete system, and shall stock all integration parts used for the installation.

P. Start-Up Service:

1. The service of a factory-trained representative shall be made available on the jobsite for one (1) six-hour period of time, to verify proper installation of the system, provide start-up, fine-tuning, and adjustment, and provide instructional operational training for the operator's personnel.

2.4 DOMESTIC COLD WATER PRESSURE BOOSTER PUMPING SYSTEM - LOW PRESSURE (100 PSI MAXIMUM BUT ONLY 80 PSI MAXIMUM ALLOWED AT ANY PLUMBUING FIXTURE, COORDINATE WITH PLUMBING SYSTEM DESIGN), IF SPECIFIED

A. Furnish and install a factory prefabricated multi-pump water pressure booster system with a separate hydro-pneumatic tank. System shall be of size and capacity as indicated on the Drawings. All wetted components of the system shall be constructed in strict compliance with ANSI/NSF-372, for low-lead content. System shall automatically provide complete pump shutdown during low-flow conditions while maintaining system pressure.

B. Pumps & Safety-Devices:

1. Pumps shall be single stage end-suction design of cast iron stainless-fitted construction, equipped with mechanical shaft seal.
2. The system shall have a separate pre-wired temperature probe and approved electrical purge valve, as well as an automatic pressure-relief valve, installed immediately downstream of each individual pump discharge nozzle.
3. Due to the potentially high outlet pressure of these safety-devices, each device shall each be piped to a common factory pre-fabricated 2" diameter drainage-header running the length of the structure, designed to dissipate the pressure energy prior to gravity drainage. Piping from the drainage-header to a waste opening shall be installed by the contractor in the field.

C. Motors:

1. Each pump shall be driven by a 3-Phase, 60 Hertz, open-drip-proof (ODP) motor. The motor shall have a synchronous speed of 3500 RPM, but shall operate at varying rates of speed during system operation. Each pump shall be driven by a NEMA Premium-Efficiency motor to keep pace with EISA protocols. Each pump must operate within the nameplate horsepower of the motor at all points along the entire pump capacity-head curve beyond the duty-point condition, reserving the available service factor of the motor as a safety-factor.
2. Pumps with performance curves which operate into the service (safety) factor, beyond the nameplate horsepower at any point, are not acceptable.

D. Hydro-Pneumatic Tank:

1. The following shall apply to all hydro-pneumatic tanks required by the pump-schedule. Furnish and install as shown on plans a pre-charged hydro-pneumatic tank or tanks. The tank shall be rated for a working pressure of 125-PSI minimum and a working temperature of 120°F minimum. All internal wetted parts must comply with FDA regulations and approvals. The tank shall be sized as scheduled.
2. The hydro-pneumatic tank shall include a replaceable flexible membrane, designed to separate the air and water. The flexible membrane shall contain the appropriate air-charge required to allow maximum water storage. A Schrader valve shall be located at the uppermost portion of the vessel, with a protective access cover. The tank shell shall be of composite material, comprised of filament-wound fiberglass, of sufficient wall thickness to contain water & air in combination, to a maximum working-pressure of 125- PSI. The unit shall have a stainless steel threaded or flanged elbow fitting,

located at the lowermost portion of the tank, to allow maximum draw-down of the stored water. The fitting shall include a diffuser, designed to enhance water flow in & out of the vessel. The tank shall be manufactured entirely of corrosion-resistant materials. Fabricated steel vessels, which are susceptible to corrosion, are not acceptable.

3. The vessel shall be installed with isolation-valves in such a way as to allow the unit to be drained for maintenance purposes, without the need to drain the pressurized pump discharge line, or cause the operation of the pump system to be interrupted.
4. The pump control system shall include a 'sleep-mode' feature, which shall increase the set-point water pressure slightly during low-flow/no-flow situations, and increase the stored water pressure within the tank, in order to stop all pumps until increased flow- demand within the facility resumes.
5. The tank shall be installed at the appropriate elevation required in order to ensure that the maximum potential operating pressure does not exceed the rated maximum working pressure of the tank. The maximum potential operating pressure shall be considered to be the sum of the zero-flow shut-off head of the pump at full-speed, plus the maximum potential suction pressure at the system suction-header.

E. Power and Control System:

1. Furnish a single or multiple enclosure power and control system in NEMA-1 enclosures. The pumping system set-point pressure shall be accurately regulated by the control system. The control system shall include an individual variable frequency drive (VFD) for each pump on the system, which shall adjust the kilowatt power delivered and used by the pump motors, as required to match the system flow demand requirement at any given time, while maintaining the set-point pressure of the system. The operating speed and kilowatt input to the pump motors shall be reduced to the minimum necessary to satisfy the flow demand, and to reduce mechanical wear of the equipment. The control system efficiency shall be maintained at 94 percent, and the system power factor shall be .95 atall times. The VFD shall always soft-start the pump motors in order to reduce momentary power demands, as well as to eliminate mechanical and hydraulic shock to the system and the facility.
2. The control system shall operate each pump independently and in-unison in order to maintain the system operating pressure set-point, as programmed by the operating engineer. Each of the pumps shall have its own VFD inverter.
3. A microprocessor based programmable logic controller (PLC) shall be furnished to process all of the operational input and output signals, including but not limited to, pressure set-points, operator selector settings, indicator lights and displays, and all alarm conditions. The logic program shall be factory installed and tested within the system and shall have provisions for field reprogramming through the use of a portable computer.

F. Pressure Transducers:

1. A system-pressure transducer shall be installed on the discharge-header of the

pumping system.

2. A suction-pressure transducer shall be installed on the suction-header of the pumping system.
3. At the discretion of the University, compliance with the ruling of the U. S. Department of Energy imposing compliance with ANSI/ASHRAE Standard 90.1-2010 Addendum-CV may be required. In such cases, as indicated on the plan drawings, a third remotely-located pressure transducer shall be provided for installation at the furthermost point of the facility, designed to reduce the kilowatt requirement of the facility, by eliminating the calculated-friction-losses during low-to-medium flow periods. This transducer shall be the primary unit, and shall be utilized by the PLC to operate the system, in order to maintain the desired remote-pressure set-point.

Fail-Safe Operation: The transducer mounted on the pump system discharge shall be the secondary transducer, and shall be a fail-safe unit, programmed to maintain system pressure, if the primary remote transducer should become inoperable.

G. System Operation:

1. System pressure and all other operating parameters shall be manually set by means of an operator interface screen on the face of the control system, as described herein. The proportional output signal from the pressure controller shall operate with internally set reset and rate response when following a pressure deviation that is within the adjusted proportional band. When pressure deviates from the set point in proportion greater than the internally adjusted proportional band, the controller shall control rapidly by bypassing rate in order to follow the rapidly changing pressure. The pressure controller shall maintain the variable speed proportional band for each pump.
2. The lead pump shall operate at varying rates of speed as required to maintain the desired system pressure. If a slight reduction of system pressure should occur when one pump is operating at the maximum programmed speed, a lag pump or multiple pumps, each as sequenced by system demand, shall accelerate and operate in-unison, to maintain stable system pressure during widely-varying flow-rate scenarios. After an adjustable period of time, the lag pump or pumps each as sequenced by demand, shall decelerate and turn off. The lead pump designation shall alternate among all pumps on the system, every 23 hours.
3. Operator adjustment options shall be provided for multiple alarm conditions.

    a. Low suction pressure alarm indication and automatic shut-down. A low suction pressure condition will shut down the system until adequate suction pressure is restored.
    b. Low system pressure alarm indication. A low system pressure condition that is not satisfied by a pump within 30 seconds will signal an alarm.
    c. High system pressure alarm indication and automatic shut-down.

4. The system shall operate completely unattended, and shall have digital dry contact

terminals for connection to the facility monitoring equipment.

5. At the discretion of the University, one (1) of the following monitoring systems may be required:

   a. Internet-Based Messaging-System: The control system shall be provided with a Metropolitan "Metro-Mail", messaging system, designed to monitor and report the status of the equipment to key personnel, during regular and/or emergency situations. The unit shall be capable of sending e-mail messages or text messages through an internet connection. The equipment control system shall include singular or multiple remote alarm contacts as designated within the equipment control system specifications. These shall be factory pre-wired to the Metro-Mail messaging system, each powered by a 10-to-30 volt ac-or-dc power supply. The messaging system shall include eight (8) electrically-separated, optically-isolated digital inputs. Each pair of input terminals shall include a red led-indicator light, which shall illuminate when the circuit is energized. The messaging system shall also include a single led-indicator status-light. This light shall glow-green to indicate that the unit is powered and is properly configured; and shall flash to indicate that an e-mail is being transmitted. The led-indicator shall glow-amber to indicate that the unit is booting, or to indicate that an ip-number has not been assigned. An ethernet port shall be provided, to allow connection of the unit to an internet connection, using a standard or crossover ethernet cable. The Metro-Mail shall include an on-board web-server, allowing the user to configure messages; e-mail addresses; and other settings, via a standard web browser. The Metro-Mail shall be powered through the main equipment control system, via a 10-to-30 vac/dc power supply.
   b. BACNet Communications Module: The control system programmable logic controller (PLC) shall be provided with a BACNet compliant or serial interface, allowing 2-way communication with the building automation network, using BACNet protocol. The module shall support 2-channel data communication: One channel shall be configured for RS-485 half-duplex serial communications; and the other channel shall be configured for 10/100M Ethernet full-duplex. The data shall be stored on-board within the module.

H. The operator devices and indicators shall include:

   1. A main power safety-disconnect for entire system.
   2. A circuit breaker or fused safety-disconnect for each VFD.
   3. A manual-off-automatic selection, for each pump.
   4. A pump-running indication, for each pump.
   5. A manual speed control - each pump.
   6. A color touch-surface operator interface screen, to monitor and adjust all system parameters.

I. The color touch-surface operator interface panel shall incorporate the following design

criteria & capabilities:

1. Incorporate a 5.6" Diagonal touch-surface, with a resolution of 320 x 234-Pixels, and Flash ROM of 4MB.
2. Capable of displaying a minimum of 65,500-colors.
3. Include an LCD display.
4. Include an LED backlight.
5. Incorporate one (1) USB Host version 1.1/1
6. Provide three (3) serial COM ports.
7. Include built-in perpetual calendar.
8. Have an operating voltage of 24Vdc.
9. Include a 3V lithium battery back-up power supply.

J. The operator interface panel shall provide trending screens, with multiple historical events:

1. Alarm event-logs, for all alarm conditions.
2. Discharge-pressure history.
3. Suction-pressure history.
4. VFD percent-speed – each VFD

K. Pump Sequencing

1. On-off sequencing shall be processed using the primary pressure signal, to enable 'sleep-mode' operation, and lead/lag pump operation. During typical daily operation, the pump sequencing at the programmed design conditions shall occur approximately as scheduled below:

(Select only one)

Duplex (2-Pump) System:	
Pump #l shall operate only	0% - 60% of peak demand
Pump #1 and #2 shall both operate	61% - 120% of peak demand
Triplex (3-Pump) System:	
Pump #l shall operate only	0% - 40% of peak demand
Pump #1 and #2 shall both operate	41% - 80% of peak demand
Pump #1, #2 and #3 shall all operate	81% - l20% of peak demand
Quadraplex (4-Pump) System:	
Pump #l shall operate only	0% - 30% of peak demand
Pump #1 and #2 shall both operate	31% - 60% of peak demand
Pump #1, #2 and #3 shall all operate	61% - 90% of peak demand
Pump #1, #2 #3 and #4 shall all operate	91% - 120% of peak demand
Pentaplex (5-Pump) System:	
Pump #l shall operate only	0% - 25% of peak demand
Pump #1 and #2 shall both operate	26% - 50% of peak demand
Pump #1, #2 and #3 shall all operate	51% - 75% of peak demand

Pump #1, #2 #3 and #4 shall all operate	76% - 100% of peak demand
Pump #1, #2 #3 #4 and #5 shall all operate	101% - 125% of peak demand

2. In order to eliminate short-cycling of the motors, the on-off pump sequencing shall be automatically restricted to a maximum of six cycles per hour, per pump, under the actual real-time load conditions.

L. Non-electronic Instrumentation:

1. The system shall include multiple individual pressure gauges; one for each pump, as well as one for indication of the total-system discharge pressure, and one for the system suction pressure. Stainless-steel or copper tubing, with isolation-valves, shall be installed between the connection-point and the gauge-location: The pressure-gauges shall be liquid-filled, and shall be mounted adjacent to one another on the control system front- panel. Each pressure gauge shall be clearly labeled with the appropriate connection- point.

M. Factory Prefabrication:

1. The entire water pressure booster system shall be factory prefabricated on a common structural steel frame & base assembly with all interconnecting piping and wiring completed and operationally tested prior to shipment. The only field connections required will be system suction and discharge headers, the drainage-header, and main power supply connection at the control panel.
2. The system shall include individual suction & discharge branch piping for each pump as well as common suction & discharge headers for the entire system. The piping & headers shall be fabricated of welded steel. The steel fabrications shall then be powder-coated with NSF-61 approved Scotchkote-134 fusion-bonded epoxy after all welding is complete, to ensure maximum corrosion-resistance.
3. A full-port threaded or flanged ball-valve or lug-type butterfly isolation valve shall be installed on the suction & discharge side of each pump, and each major component.
4. A threaded, flanged, or lug-type silent check valve shall be installed on the discharge side of each pump, between the pump & associated isolation valve. Projects within the city of Chicago shall also include a silent check valve on the suction side of each pump.
5. The piping, fittings, valves, and associated devices shall be pressure-rated as required to ensure that the maximum potential operating pressure of the system does not exceed the rated maximum working pressure of the components. The maximum potential operating pressure of the system shall be considered to be the sum of the zero-flow shut-off head of any pump at full-speed, plus the maximum potential suction pressure at the suction- header.
6. All piping, headers, valves, and associated devices shall be fully supported by the system's structural steel frame & base assembly. Support of the piping, headers, etc., by field-installed devices is not acceptable.

7. The diameter of the piping, valves, and headers shall be sized to minimize the full-flow velocity, as required to meet local code requirements, or engineer-approved acceptable velocity levels. When local code requirements are unclear, velocities may not exceed single-digit levels, as measured in feet-per-second, at full-flow.
8. When a remotely-located pressure transducer is required by the contract, it shall be plumbed in place along with a liquid-filled pressure-gauge, in the piping provided by the plumbing contractor, in the remote location indicated. The instrumentation contractor shall provide, route, and install the signal-cable from the transducer's remotely installed location, and shall terminate the cable in the water pressure booster system control panel.

N. Factory Test and Certification:

1. The fully-assembled system shall be factory flow-tested in the manufacturer's test-lab before shipment, to ensure correct operation. All of the specified functional & performance requirements are essential to project economics and are therefore subject to performance verification. Equipment that is found to be deficient with respect to these requirements shall not be accepted and shall be replaced at the contractor's expense with equipment that can meet these requirements. The flow-test shall be performed & certified in writing by a registered professional engineer (P. E.), at the expense of themanufacturer. The plumbing design engineer shall be provided the opportunity of a factory inspection and witness-testing of the system prior to shipment from the manufacturing plant, (not the distributor's facility), to ensure quality and specification- compliance. All costs associated with the inspection & witness-testing, including travel- expenses & lodging-expenses, shall be included in the manufacturer's price. Test shall include a system operating flow test from zero to 120% design flow rate under specified suction and net delivery pressure conditions.
2. Certification shall be provided to the plumbing design engineer for approval. Prior to shipment of the system from the factory. The certification must be approved in writing by the plumbing design engineer. The certification shall include copies of the test data as recorded by X-Y plotter, certified in writing by the registered professional engineer (P. E.) performing and witnessing the test.

O. Qualification Of Equipment Manufacturer:

1. In order to establish a standard of quality and to insure a uniform basis of bidding, the system shall be manufactured by Metropolitan Industries, Inc., or a written approval equal. To be considered an approved equal, complete details and shop drawings must be submitted to the engineer no later than ten (10) days prior to the bid date. Sufficient data must be submitted so that the engineer has the required information available to determine whether the alternate system meets the requirements of the specifications. The contractor shall prepare his bid on the basis of the specific system specified for purposed of determining the low bid. After the execution of the contract, substitution of non-specified equipment will be considered, if the substitution is, in the opinion of the engineer, equal in quality,

substance, and performance to the named manufacturer. If such substitution is approved by the engineer, all savings affected by the contractor in the purchase of the substituted equipment shall be passed on to the owner by reducing the contract price. In submitting for substitution, the contractor shall provide certified copies of equipment proposals from the named manufacturer, as well as the substitute manufacturer.

2. The equipment manufacturer shall furnish 24 hour service for the complete system, and shall stock all integration parts used for the installation.

P. Start-Up Service:

1. The service of a factory-trained representative shall be made available on the jobsite for one (1) six-hour period of time, to verify proper installation of the system, provide start-up, fine-tuning, and adjustment, and provide instructional operational training for the operator's personnel.

2.5 ELECTRIC WATER COOLERS, IF SPECIFIED

A. Water Coolers, EWC:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product by the following:

   a. Elkay Manufacturing Co. (Basis of Design, Model EZSTL8WS(VR)*K).

2. Description: Bi-level, lead-free, dual cabinet, vandal resistant, ADA accessible model for adults and children, ARI 1010, UL 399, NSF/ANSI 61 and 372, wall mounted water cooler with bottle filling station.

   a. Cabinets: Bi-level, with stainless steel basins and bottle filler wrapper (with ABS plastic alcove), and galvanized steel structure and stainless steel cabinetry.
   b. Bubblers: One, safety type, with adjustable stream regulators, located on each cabinet deck.
   c. Control: Push bar on front of each cabinet, and on sides.
   d. Bottle filling unit shall have touchless electronic activation with an auto 20 second shut-off timer, and an electronic display showing count of plastic bottles saved from waste.
   e. Supply: 3/8 inch with ball valve.
   f. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
   g. Drain: Grid with 1-1/4 inch minimum horizontal waste and trap complying with ASME A112.18.2.
   h. Integrated silver ion anti-microbil protection shall be provided in key areas.

i. Cooling System: Electric, with hermetically sealed compressor, R-134a refrigerant, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.

1) Capacity: 8 GPH of 50 deg F cooled water from 80 deg F inlet water and 90 deg F ambient air temperature.
2) Electrical Characteristics: 120-V ac; single phase; 60 Hz.

j. Support: Type II, water cooler carrier.

2.6 SUMP PUMP SYSTEMS – DUPLEX – SUBMERSIBLE VORTEX OR SEMI-OPEN, IF SPECIFIED

A. Provide submersible sump pump systems, with digital process-controller, and two (2) digital level switches. The pumping system shall be designed for operation on single-phase power supplies, with pumps of the sizes and capacities as noted on the drawings. The pumps shall include either recessed vortex-type impellers, or semi-open impellers. The pumping systems shall be as manufactured by Metropolitan Industries, of Romeoville, IL.

B. An epoxy-coated steel basin cover shall be provided, and shall include sealed discharge pipe openings, inspection-opening and suspension devices for the level control level-switches.

C. Pump construction and design.

1. The pumps shall submersible type, with either fully-recessed vortex or semi-open impeller design.
2. The pumps shall be cast iron, stainless-fitted, designed with a stainless steel shaft, bearings, and a mechanical seal in an oil-filled chamber.
3. Each pump shall be driven by a single-phase motor, with built-in capacitors, as scheduled. The motor shall be oil-filled, for positive lubrication and heat-dissipation. Air- Filled motors, which must be fully-submerged at all times in order to dissipate heat, are not acceptable.

D. Process Control Unit.

1. Provide a single enclosure power and control enclosure (NEMA 1). The enclosure shall be a fiberglass composite material, and shall include a clear hinged-door, which shall allow maintenance personnel to monitor the process-controller without opening the door.
2. The enclosure shall include a main circuit-breaker, and a solid-state digital process- controller. The controller shall have the UL listing mark for industrial control panels Relay-based control systems, which do not allow the flexibility of being re-programmed in the field when software upgrades are programmed, are not acceptable.
3. The pump & level switch power cords shall enter the enclosure through specialized

grommets, designed to allow cord-plugs to be used, while providing a secure seal from the surrounding environment.

4. The process controller shall operate as follows:

   a. The electronic level-control system shall operate through the use of two (2) solid- state strain-gauge type level-sensors.
   b. The control system shall allow the user the ability to enter the menu-selections & wet-well level-setting adjustments through the use of digital touch-pad controls on the face of the controller, without the need to access the wet-well.
   c. The process-controller shall be designed with the following fail-safe operational features and indicators:

      1) The process-controller shall operate one pump during normal scenarios. The controller software shall be programmed to provide automatic alternating operation, in the event that a second pump is included or added to the system, by automatically alternating the pumps on each pumping cycle.
      2) The unit shall continually monitor the functionality of the level-sensors and all pumps. The controller will enter a 'state-of-alarm' during pump-failure, sensor-failure, a high-level condition, or if excessive run-time is detected.
      3) If one of the wet-well level-switches become inoperable, the fail-safe self- diagnostic process-controller shall be designed to continue uninterrupted automatic operation of one or both pumps, and all alarms & faults.

   d. The process-controller shall include the following indicators:

      1) One (1) power-on light.
      2) One (1) LCD menu & selection display screen.
      3) Two (2) touch-pad keys for up & down operator menu selection adjustments.
      4) Two (2) pump-run lights.
      5) One (1) alarm light.
      6) Two (2) level-sensor status lights.
      7) One (1) silence touch-pad to mute the audible alarm.
      8) One (1) reset touch-pad to reset the system configuration.

   e. The process-controller shall perform the following major functions:

      1) Start and stop 1-pump during normal flow conditions.
      2) Start and stop 2-pumps during extreme flow conditions, if two pumps are connected.
      3) Alternate two pumps on successive cycles of operation.
      4) Monitor & delay pump-starts to avoid short-cycling motors.
      5) Monitor & delay pump-starts to avoid simultaneous starting of pumps

following utility power losses.

6) Monitor & recognize inoperable level-switches, and modify system operation to compensate for this occurrence.
7) Provide easily identifiable alarm codes for the operating personnel to monitor.

f. The control system shall include the following devices, for use in remotely monitoring the system:

1) One (1) set: digital dry alarm contacts, to indicate state of alarm.
2) The control system shall be provided with a Metropolitan "Metro-Mail", messaging system, designed to monitor and report the status of the equipment to key personnel, during regular and/or emergency situations. The unit shall be capable of sending e-mail messages or text messages through an internet connection. The equipment control system shall include singular or multiple remote alarm contacts as designated within the equipment control system specifications. These shall be factory pre-wired to the Metro-Mail messaging system, each powered by a 10-to-30 volt ac-or-dc power supply. The messaging system shall include eight (8) electrically- separated, optically-isolated digital inputs. Each pair of input terminals shall include a red led-indicator light, which shall illuminate when the circuit is energized. The messaging system shall also include a single led-indicator status-light. This light shall glow-green to indicate that the unit is powered and is properly configured; and shall flash to indicate that an e-mail is being transmitted. The led-indicator shall glow-amber to indicate that the unit is booting, or to indicate that an ip-number has not been assigned. An ethernet port shall be provided, to allow connection of the unit to an internet connection, using a standard or crossover ethernet cable. The Metro-Mail shall include an on-board web-server, allowing the user to configure messages; e-mail addresses; and other settings, via a standard web browser. The Metro-Mail shall be powered through the main equipment control system, via a 10-to-30 vac/dc power supply.

g. Control systems without all of the essential fail-safe operational features, lights, fault-codes, indicators, and remote-monitoring devices listed above are insufficient for the intended service, and are not acceptable.

E. Liquid level sensors.

1. Provide two (2) suspended solid-state digital level-switches, of the strain-gauge type, designed with no moving parts. Mechanically operated switches, which are more susceptible to failure, are not acceptable. Cord grips fastened to the basin-cover shall be used to support the level-switch cords. The switches shall be fastened to a stainless-steel chain with anchor, in such a way that allows level-adjustment of the

switches from above the basin cover. These level-switches shall be used to control & monitor liquid level in the wet-well.

F. Qualification Of Equipment Manufacturer:

1. In order to establish a standard of quality and to insure a uniform basis of bidding, the system shall be manufactured by Metropolitan Industries, Inc., or a written approval equal approved by FMDC and FMO. To be considered an approved equal, complete details and shop drawings must be submitted to the engineer no later than ten (10) days prior to the bid date. Sufficient data must be submitted so that the engineer has the required information available to determine whether the alternate system meets the requirements of the specifications. The contractor shall prepare his bid on the basis of the specific system specified for purposed of determining the low bid. After the execution of the contract, substitution of non-specified equipment will be considered, if the substitution is, in the opinion of the engineer, equal in quality, substance, and performance to the named manufacturer. If such substitution is approved by the engineer, all savings affected by the contractor in the purchase of the substituted equipment shall be passed on to the owner by reducing the contract price. In submitting for substitution, the contractor shall provide certified copies of equipment proposals from the named manufacturer, as well as the substitute manufacturer.
2. The equipment manufacturer shall furnish 24 hour service for the complete system, and shall stock all integration parts used for the installation.

G. Start-Up Service:

1. The service of a factory-trained representative shall be made available on the jobsite for one (1) six-hour period of time, to verify proper installation of the system, provide start-up, and adjustment, and provide instructional operational training for the operator's personnel.

2.7 SEWAGE EJECTOR PUMP SYSTEMS – DUPLEX – SUBMERSIBLE VORTEX, IF SPECIFIED

A. Provide submersible vortex sewage pump systems, with digital process-controller, and two (2) digital level switches. The pumping system shall be designed for operation on single-phase power supplies, with pumps of the sizes and capacities as noted on the drawings. The pumping systems shall be as manufactured by Metropolitan Industries, of Romeoville, IL.

B. An epoxy-coated steel basin cover shall be provided, and shall include sealed discharge pipe openings, inspection-opening and suspension devices for the level control level-switches.

C. Pump construction and design.

1. The pumps shall submersible recessed-impeller vortex type designed so that all solids

pass through the volute, without passing through the impeller.

2. Pump designs which require solids to pass through the impeller on the way through the volute, which can tend to cause solids to become lodged between the impeller-blades and volute more easily, are not acceptable.
3. The pumps shall be cast iron, stainless-fitted, designed with a stainless steel shaft, bearings, and a mechanical seal in an oil-filled chamber.
4. Each pump shall be driven by a single-phase motor, with built-in capacitors, as scheduled. The motor shall be oil-filled, for positive lubrication and heat-dissipation. Air- Filled motors, which must be fully-submerged at all times in order to dissipate heat, are not acceptable.

D. Process Control Unit.

1. Provide a single enclosure power and control enclosure (NEMA 1). The enclosure shall be a fiberglass composite material, and shall include a clear hinged-door, which shall allow maintenance personnel to monitor the process-controller without opening the door.
2. The enclosure shall include a main circuit-breaker, and a solid-state digital process-controller. The controller shall have the UL listing mark for industrial control panels. Relay-based control systems, which do not allow the flexibility of being re-programmed in the field when software upgrades are programmed, are not acceptable.
3. The pump & level switch power cords shall enter the enclosure through specialized grommets, designed to allow cord-plugs to be used, while providing a secure seal from the surrounding environment.
4. The process controller shall operate as follows:

    a. The electronic level-control system shall operate through the use of two (2) solid- state strain-gauge type level-sensors.
    b. The control system shall allow the user the ability to enter the menu-selections & wet-well level-setting adjustments through the use of digital touch-pad controls on the face of the controller, without the need to access the wet-well.
    c. The process-controller shall be designed with the following fail-safe operational features and indicators:

        1) The process-controller shall operate one pump during normal scenarios. The controller software shall be programmed to provide automatic alternating operation, in the event that a second pump is included or added to the system, by automatically alternating the pumps on each pumping cycle.
        2) The unit shall continually monitor the functionality of the level-sensors and all pumps. The controller will enter a ‘state-of-alarm’ during pump-failure, sensor-failure, a high-level condition, or if excessive run-time is detected.
        3) If one of the wet-well level-switches become inoperable, the fail-safe

self- diagnostic process-controller shall be designed to continue uninterrupted automatic operation of one or both pumps, and all alarms & faults.

d. The process-controller shall include the following indicators:

1) One (1) power-on light.
2) One (1) LCD menu & selection display screen.
3) Two (2) touch-pad keys for up & down operator menu selection adjustments.
4) Two (2) pump-run lights.
5) One (1) alarm light.
6) Two (2) level-sensor status lights.
7) One (1) silence touch-pad to mute the audible alarm.
8) One (1) reset touch-pad to reset the system configuration.

e. The process-controller shall perform the following major functions:

1) Start and stop 1-pump during normal flow conditions.
2) Start and stop 2-pumps during extreme flow conditions, if two pumps are connected.
3) Alternate two pumps on successive cycles of operation.
4) Monitor & delay pump-starts to avoid short-cycling motors.
5) Monitor & delay pump-starts to avoid simultaneous starting of pumps following utility power losses.
6) Monitor & recognize inoperable level-switches, and modify system operation to compensate for this occurrence.
7) Provide easily identifiable alarm codes for the operating personnel to monitor.

f. The control system shall include the following devices, for use in remotely monitoring the system:

1) One (1) set: digital dry alarm contacts, to indicate state of alarm.

2) The control system shall be provided with a Metropolitan "Metro-Mail", messaging system, designed to monitor and report the status of the equipment to key personnel, during regular and/or emergency situations. The unit shall be capable of sending e-mail messages or text messages through an internet connection. The equipment control system shall include singular or multiple remote alarm contacts as designated within the equipment control system specifications. These shall be factory pre-wired to the Metro-Mail messaging system, each powered by a 10-to-30 volt ac-or-dc power supply. The messaging system shall include eight (8) electrically- separated, optically-isolated digital inputs. Each pair of input terminals shall include a red led-

indicator light, which shall illuminate when the circuit is energized. The messaging system shall also include a single led-indicator status-light. This light shall glow-green to indicate that the unit is powered and is properly configured; and shall flash to indicate that an e-mail is being transmitted. The led-indicator shall glow-amber to indicate that the unit is booting, or to indicate that an ip-number has not been assigned. An ethernet port shall be provided, to allow connection of the unit to an internet connection, using a standard or crossover ethernet cable. The Metro-Mail shall include an on-board web-server, allowing the user to configure messages; e-mail addresses; and other settings, via a standard web browser. The Metro-Mail shall be powered through the main equipment control system, via a 10-to-30 vac/dc power supply.

g. Control systems without all of the essential fail-safe operational features, lights, fault-codes, indicators, and remote-monitoring devices listed above are insufficient for the intended service, and are not acceptable.

E. Liquid level sensors.

1. Provide two (2) suspended solid-state digital level-switches, of the strain-gauge type, designed with no moving parts. Mechanically operated switches, which are more susceptible to failure, are not acceptable. Cord grips fastened to the basin-cover shall be used to support the level-switch cords. The switches shall be fastened to a stainless-steel chain with anchor, in such a way that allows level-adjustment of the switches from above the basin cover. These level-switches shall be used to control & monitor liquid level in the wet-well.

F. Qualification Of Equipment Manufacturer:

1. In order to establish a standard of quality and to insure a uniform basis of bidding, the system shall be manufactured by Metropolitan Industries, Inc., or a written approval equal approved by FMDC and FMO. To be considered an approved equal, complete details and shop drawings must be submitted to the engineer no later than ten (10) days prior to the bid date. Sufficient data must be submitted so that the engineer has the required information available to determine whether the alternate system meets the requirements of the specifications. The contractor shall prepare his bid on the basis of the specific system specified for purposed of determining the low bid. After the execution of the contract, substitution of non-specified equipment will be considered, if the substitution is, in the opinion of the engineer, equal in quality, substance, and performance to the named manufacturer. If such substitution is approved by the engineer, all savings affected by the contractor in the purchase of the substituted equipment shall be passed on to the owner by reducing the contract price. In submitting for substitution, the contractor shall provide certified copies of equipment proposals from the named manufacturer, as well as the substitute manufacturer.

2. The equipment manufacturer shall furnish 24 hour service for the complete system, and shall stock all integration parts used for the installation.

G. Start-Up Service:

1. The service of a factory-trained representative shall be made available on the jobsite for one (1) six-hour period of time, to verify proper installation of the system, provide start-up, and adjustment, and provide instructional operational training for the operator's personnel.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Use carrier off-floor supports for wall-mounting equipment, unless otherwise indicated.

B. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view.

3.2 INSTALLATION

A. Install all equipment per the manufacturer's instructions, and install floor mounted pump packages on 4" concrete housekeeping pads.

B. Install off-floor supports affixed to building substrate and attach wall-mounting equipment, unless otherwise indicated.

C. Install equipment level and plumb. For equipment indicated for children, install at height required by authorities having jurisdiction.

D. Install water-supply piping with shutoff valve on supply to each piece of equipment to be connected to water distribution piping. Use ball valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

E. Install trap and waste piping on drain outlet of each water cooler to be connected to sanitary drainage system.

F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 22 Section "Escutcheons for Plumbing Piping."

G. Seal joints between water coolers and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to cooler color. Sealants are specified in Division 07 Section "Joint

Sealants."

3.3 FIELD QUALITY CONTROL

A. Equipment Testing: After electrical circuitry has been energized, test equipment for compliance with requirements. Test and adjust controls and safeties.

1. Remove and replace malfunctioning units and retest as specified above.
2. Report test results in writing.

B. Properly disinfect equipment handling potable water.

3.4 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install in accordance with manufacturer's instructions.

C. Comply with Section 22 0529 "Hangers and Supports for Plumbing Piping and Equipment"

3.5 CONNECTIONS

A. Comply with requirements for piping specified in Section 22 1118 "Domestic Water Distribution System" for water piping, and Section 22 1316 for sanitary drainage piping. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with Division 26 Sections for electrical connections and for wiring methods.

C. Connect controls as required.

D. Install piping adjacent to pumps/packages to allow service and maintenance.

E. Connect domestic water piping to booster pump package inlet and outlet. Install suction and discharge piping equal to or greater than size of package inlets and outlets.

1. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Section 22 0523 "General-Duty Valves for Plumbing Piping" and comply with requirements for strainers specified in Section 22 2114 "Plumbing Specialties."

2. Install pressure gage at suction of each pump and pressure gage at discharge of each pump. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Comply with requirements for pressure gages and snubbers specified

in Section 22 0519 "Meters and Gages for Plumbing Piping."

3.6 ADJUSTING AND TESTING

A. Adjust pumps and other components to function smoothly and to deliver the specified flows, and lubricate motors and pumps as recommended by manufacturer.

B. Adjust initial pressure set points.

C. Set field-adjustable level and electrical switches and circuit-breaker trip ranges as indicated.

D. Adjust fixture flow regulators for proper flow and stream height.

E. Adjust water cooler temperature settings.

F. Perform complete testing on equipment per manufacturer's requirements and submit reports.

END OF SECTION

SECTION 221118 - DOMESTIC WATER DISTRIBUTION SYSTEM

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
1. Provide Payment and Performance Bonds for the full value of their Subcontract.
2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
1. Comply with the Instructions to Bidders.
2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
FILED SUBCONTRACTOR'S BID FOR SECTION:
22 11 18 – DOMESTIC WATER DISTRIBUTION SYSTEM

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
1. All subcontractors to the Filed Subcontractor, whose work is:
a. Valued at $10,000 or more.
2. The contract sum for each subcontractor required to be listed.
a. An affidavit that all subcontractors named on the Filed Subcontractor's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
4. Comply with the applicable New York General Laws and the following:
a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the

Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None.	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. P0.01 – Plumbing Schedules and Details
2. P0.02 – Plumbing Notes
3. P0.03 – SMT Rough-In Details
4. P0.04 – Sanitary Waste and Natural Gas Riser Diagrams
5. P1.01 – Sanitary Plan
6. P2.01 – Water Piping Plan
7. P3.01 – Natural Medical/Gas and Storm Drainage Plan
8. P3.02 – Roof Natural Gas and Storm Drainage Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 22 00 00 – Common Work Results for Plumbing
2. Section 22 05 13 – Common Motor Requirements for Plumbing Equipment
3. Section 22 05 16 – Expansion Fittings and Loops for Plumbing Piping
4. Section 22 05 17 – Sleeves and Sleeve Seals for Plumbing
5. Section 22 05 18 – Escutcheons for Plumbing Piping
6. Section 22 05 19 – Meter and Gauges for Plumbing
7. Section 22 05 23 – General Duty Valves for Plumbing Piping
8. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
9. Section 22 05 48 – Vibration Controls for Plumbing Piping and Equipment
10. Section 22 05 53 – Identification for Plumbing Piping and Equipment
11. Section 22 07 00 – Plumbing Insulation
12. Section 22 08 00 – Commissioning of Plumbing Systems
13. Section 22 10 00 – Plumbing Equipment
14. Section 22 11 18 – Domestic Water Distribution System
15. Section 22 11 19 – Plumbing Specialties
16. Section 22 13 16 – Sanitary Waste and Vent Piping
17. Section 22 13 19 – Sanitary Waste Piping Specialties
18. Section 22 31 00 – Domestic Water Softeners
19. Section 22 34 00 – Domestic Water Heaters
20. Section 22 40 00 – Plumbing Fixtures

B. Alternates: None.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.4 SUMMARY

A. Section Includes:

1. Under-building slab supply, and aboveground domestic water supply and recirculation pipes, tubes, fittings, and certain specialties inside the building from 1’-0” above finished floor or 1’-0” inside the exterior wall as shown on the drawings, and as coordinated with the related work of Division 33.
2. Flexible connectors.
3. Piping encasement.
4. Water meters.
5. Application of valves.

B. Related Sections:

1. Division 33 Section "Facility Water Distribution Piping" for water-service piping outside the building from the source to a point 1’-0” above finished floor or 1’-0” inside the exterior wall of the building as shown on the drawings.
2. Division 22 0523 "General Duty Valves for Plumbing Piping"
3. Section 22 0000 "Common Work Results of Plumbing."
4. Section 22 2114 "Plumbing Specialties."
5. Section 22 4000 "Plumbing Fixtures."
6. Section 22 4500 "Plumbing Equipment."

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

C. Field quality-control reports.

D. For any systems requiring State code pre-approval, provide letters from the State for same.

E. Documentation that proposed products meet California Health and Safety Code 116875 (AB 1953) - 2010, for 25% low lead content of piping, pipe fittings, and faucets for water intended for human consumption.

F. At closeout, Northwestern University Maintenance Requirement Forms, see Division 01 for more information.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with California Health and Safety Code 116875 (AB 1953) - 2010, for 25% low lead content of piping, pipe fittings, and faucets for water intended for human consumption, and NSF/ANSI Standard 61, including Annex G-2010 - Drinking Water System Components - Low Lead Content Requirement.

C. To assure uniformity and compatibility of piping components in grooved end piping systems, all grooved products utilized shall be supplied by the same manufacturer.

D. All grooved couplings shall be installed strictly according to grooved manufacturer's instructions including torque verification and specific lubrication as published.

E. Flexible connectors shall be installed according to the manufacturer's instructions, with any adjacent special pipe support/guiding required.

F. Comply with FM Global requirements for cross connections, and for any pressure reducing valves for fire protection service.

1.7 SPECIAL WARRANTIES

A. Five (5) years, see Division 01 for more information.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
5. Grooved-End Copper Fittings: ASTM B 75 copper tube, or ASTM B 152 wrought

copper, with copper tubing sized grooved ends designed to accept grooved couplings. Flaring of tube and fitting ends to IPS dimensions is not permitted.

6. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile- iron housing with keys matching pipe and fitting grooves: 2" through 8": Installation ready rigid coupling with Grade EHP/EPDM gaskets (unless noted otherwise herein) rated for maximum 250 deg F for use with housing, and steel bolts and nuts. Victaulic Style 607.
7. Grooved-End-Tube Mechanical Tube Fittings: Copper-tube dimensions and design similar to AWWA C606. Bronze upper housing and copper-colored enamel coated ductile iron lower housing, threaded outlet and locating collar, EPDM synthetic rubber gasket suit able for hot and cold water, and bolts and nuts. Victaulic Style 622.

2.3 DUCTILE-IRON PIPE AND FITTINGS (For 3" and Larger Pipe Sizes)

A. Mechanical-Joint, Ductile-Iron Pipe:

1. AWWA C151/A21.51, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Standard-Pattern, Mechanical-Joint Fittings:

1. AWWA C110/A21.10, ductile or gray iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Compact-Pattern, Mechanical-Joint Fittings:

1. AWWA C153/A21.53, ductile iron.
2. Glands, Gaskets, and Bolts: AWWA C111/A21.11, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

D. Plain-End, Ductile-Iron Pipe: AWWA C151/A21.51.

2.5 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.

B. Metal, Pipe-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. Shall be Lead free NSF/ANSI 61 compliant.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated. Shall be Lead free NSF/ANSI 61 compliant.

E. Flux: ASTM B 813, water flushable.

F. Pipe Thread Tape: Food grade commercial duty pipe thread sealant tape only.

2.6 TRANSITION FITTINGS

A. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

B. Sleeve-Type Transition Coupling: AWWA C219.

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Flanges:

1. Description:

a. Factory-fabricated, bolted, companion-flange assembly.
b. Pressure Rating: 150 psig.
c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder- joint copper alloy and threaded ferrous.

C. Dielectric-Flange Kits:

1. Description:

a. Nonconducting materials for field assembly of companion flanges.
b. Pressure Rating: 150 psig.
c. Gasket: Neoprene or phenolic.
d. Bolt Sleeves: Phenolic or polyethylene.
e. Washers: Phenolic with steel backing washers.

D. Dielectric Couplings:

1. Description:

    a. Galvanized-steel coupling.
    b. Pressure Rating: 300 psig at 225 deg F.
    c. End Connections: Female threaded.
    d. Lining: Inert and noncorrosive, thermoplastic.

E. Dielectric Nipples:

1. Description:

    a. Electroplated steel nipple complying with ASTM F 1545.
    b. Pressure Rating: 300 psig at 225 deg F.
    c. End Connections: Male threaded or grooved.
    d. Lining: Inert and noncorrosive, propylene.

2.8 FLEXIBLE CONNECTORS

A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig (1380 kPa).
2. End Connections NPS 2 (DN 50) and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged copper alloy.

B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig (1380 kPa).
2. End Connections NPS 2 (DN 50) and Smaller: Threaded stainless steel pipe nipple.
3. End Connections NPS 2-1/2 (DN 65) and Larger: Flanged stainless steel pipe nipple.

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flex-Hose.
2. Flexicraft.
3. Hyspan.
4. Flex Precision.

2.9 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105/A21.5.

B. Form: Sheet or tube.

C. Color: Black or natural

2.10 WATER METERS

A. Water meter type to be as indicated on the drawings, and they must meet University and local water purveyor requirements.

B. Turbine-Type Water Meters:

1. Description:

a. Standard: AWWA C701.
b. Pressure Rating: 150-psig working pressure.
c. Body Design: Turbine; totalization meter.
d. Registration: In gallons or cubic feet as required by utility company.
e. Case: Bronze.
f. End Connections for Meters NPS 2 and Smaller: Threaded.
g. End Connections for Meters NPS 2-1/2 and Larger: Flanged.
h. For vertical or horizontal mounting.

C. Compound-Type Water Meters:

1. Description:

a. Standard: AWWA C702.
b. Pressure Rating: 150-psig working pressure.
c. Body Design: With integral mainline and bypass meters; totalization meter.
d. Registration: In gallons or cubic feet as required by utility company.
e. Case: Bronze.
f. Pipe Connections: Flanged.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Division 31 2000 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping and related components. Indicated locations and arrangements are

used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook" and no joints allowed under slabs.

C. The maximum developed length of 1/2" diameter piping shall be 10'.

D. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

E. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105/A21.5.

F. No joints or fittings in lines below floors after the facility water entry assembly.

G. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Plumbing Specialties" for drain valves and strainers.

H. Install shutoff valve immediately upstream of each dielectric fitting.

I. Install domestic water piping level and plumb.

J. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

K. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

L. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

M. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

N. Install piping adjacent to equipment and specialties to allow service and maintenance.

O. Install piping to permit valve servicing.

P. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher

than system pressure rating used in applications below unless otherwise indicated.

Q. Install piping free of sags and bends.

R. Install fittings for changes in direction and branch connections.

S. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

T. Provide proper access to components and work that require inspection, repair, service, or maintenance.

U. No piping with a fluid shall be routed over electrical busway housings. For electrical busway housings, provide a minimum 36" inches on top, both sides, and the bottom.

V. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.

W. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

X. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Common Work Results for Plumbing."

Y. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Common Work Results for Plumbing."

Z. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Common Work Results for Plumbing."

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and

restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter. Shall be Lead free NSF/ANSI 61 compliant.

E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook." Shall be Lead free NSF/ANSI 61 compliant.

F. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.

G. Joint Construction for Grooved-End, Ductile-Iron Piping: Make radius cut joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

H. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

I. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

J. Grooved Joints for Copper Piping: Roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Grooved end shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. A representative shall provide on-site training for contractor's field personnel. Contractor shall remove and replace any improperly installed products.

3.4 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations. Shall be Lead free NSF/ANSI 61 compliant.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures

or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball valves for piping NPS 2 and smaller. Use OS&Y or NRS gate valves for piping NPS 2-1/2 and larger.

C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."

1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.

E. For isolation valves at water heaters, install valves that relieve heater pressure when closed.

3.5 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

C. Transition Fittings in Underground Domestic Water Piping:

1. NPS 1-1/2 and Smaller: Fitting-type coupling.
2. NPS 2 and Larger: Sleeve-type coupling.

3.6 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing. Shall be Lead free NSF/ANSI 61 compliant.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

D. Dielectric Fittings for NPS 5 to NPS 6: Use dielectric flange kits.

3.7 FLEXIBLE CONNECTOR INSTALLATION

A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water boosterpump.

B. Install bronze-hose flexible connectors in copper domestic watertubing.

C. Install stainless-steel-hose flexible connectors in non-copper domestic waterpiping.

3.8 WATER METER INSTALLATION

A. Rough-in domestic water piping, and install water meter as indicated on the drawings according to AWWA M6 and the utility company's requirements.

B. Install water meters with shutoff valves on water-meter inlet and outlet. Provide a valved bypass around meter only if required by the utility company. Support meters, valves, and piping on brick or concrete piers.

3.9 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products andinstallation.

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.

3. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to aminimum of 3/8 inch.

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

F. Install hangers for ductile iron piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3: 12 feet with 1/2-inch rod.
2. NPS 4: 12 feet with 5/8-inch rod.
3. NPS 6: 12 feet with 3/4-inch rod.
4. NPS 8 and Larger: 12 feet with 3/4-inch rod.

G. Install supports for vertical ductile iron piping every 15 feet.

3.10 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to water-service piping at a point 1'-0" above finished floor or 1'- 0" inside the exterior wall, as shown on the drawings, with a shutoff valve using a transition fitting to join dissimilar piping materials then extend and connect to the following:

1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.11 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.12 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction, FMDC and FMO.
2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

    a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
3. Re-inspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for re-inspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Fill domestic. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig above operating pressure, minimum of 100 psi, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

D. Domestic piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.13 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

    a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
    b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.14 CLEANING

A. Clean and disinfect potable domestic water piping as follows (and in accordance with local code and jurisdiction):

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

    c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.15 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Under-building-slab, domestic water piping, NPS 2 1/2 and smaller, shall be the following:

1. Soft copper tube, ASTM B 88, Type K; no joints allowed under floor slabs.

D. Under-building-slab, domestic water piping, NPS 3 and larger, shall be the following:

1. Ductile Iron; with ductile iron fittings, and mechanical joints.

E. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:

1. Hard copper tube, ASTM B 88, Type L; cast or wrought copper solder-joint fittings; and soldered joints. Shall be Lead Free NSF/ANSI 61 compliant.

F. Aboveground domestic water piping, NPS 2 1/2, shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L; cast or wrought copper braze joint fittings; and brazed joints. Shall be Lead Free NSF/ANSI 61 compliant.
2. Hard copper tube, ASTM B 88, Type L; grooved, with matching fittings; and roll grooved joints. Shall be Lead Free NSF/ANSI 61 compliant.

G. Aboveground domestic water piping, NPS 3 and 4, shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L; cast or wrought copper braze-joint fittings; and brazed joints. Shall be Lead Free NSF/ANSI 61 compliant.
2. Hard copper tube, ASTM B 88, Type L; grooved, with matching fittings; and roll grooved joints. Shall be Lead Free NSF/ANSI 61 compliant.
3. Ductile Iron; with ductile iron fittings, and mechanical or grooved joints. Shall be Lead Free NSF/ANSI 61 compliant.

H. Aboveground domestic water piping, NPS 6 and Larger, shall be the following:

1. Ductile Iron; with ductile iron fittings, and mechanical or grooved joints.
2. Galvanized pipe with mechanical joints.

3.16 VALVE SCHEDULE (Including Access to Same)

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller. Use OS&Y or NRS gate valves or ball valves with flanged ends for piping NPS 2-1/2 and larger (ball valves only to 3"). Shall be Lead Free NSF/ANSI 61 compliant.
2. Throttling Duty: Use ball valves for piping NPS 2 and smaller. Shall be Lead Free NSF/ANSI 61 compliant.
3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
4. Drain Duty: Hose-end drain valves. Shall be Lead Free NSF/ANSI 61 compliant.
5. Faucets and fixtures, such as emergency showers, eyewashes, dishwashers, and autoclaves, shall have local shutoff valves within 5' of the faucet/fixture. Valves must be readily accessible. Shall be Lead Free NSF/ANSI 61 compliant.
6. Shut-off isolation valves shall be provided on the branch lines no more than 18" off of the main lines or risers. Additional shut-off isolation valves may be needed further down the branch lines also, and are to be provided to the satisfaction of the University. Shall be Lead Free NSF/ANSI 61 compliant.

B. Iron grooved-end valves may be used with grooved-end piping. Shall be Lead Free NSF/ANSI 61 compliant.

C. Access panels shall be provided for any plumbing valves that may be in walls or in-accessible ceilings. Access panels shall be a minimum of 12" x 12".

END OF SECTION

SECTION 221119 - PLUMBING SPECIALTIES

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
1. Provide Payment and Performance Bonds for the full value of their Subcontract.
2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
1. Comply with the Instructions to Bidders.
2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
FILED SUBCONTRACTOR'S BID FOR SECTION:
22 11 19 – PLUMBING SPECIALTIES

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
1. All subcontractors to the Filed Subcontractor, whose work is:
a. Valued at $10,000 or more.
2. The contract sum for each subcontractor required to be listed.
a. An affidavit that all subcontractors named on the Filed Subcontractor's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
4. Comply with the applicable New York General Laws and the following:
a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the

Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None.	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. P0.01 – Plumbing Schedules and Details
2. P0.02 – Plumbing Notes
3. P0.03 – SMT Rough-In Details
4. P0.04 – Sanitary Waste and Natural Gas Riser Diagrams
5. P1.01 – Sanitary Plan
6. P2.01 – Water Piping Plan
7. P3.01 – Natural Medical/Gas and Storm Drainage Plan
8. P3.02 – Roof Natural Gas and Storm Drainage Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 22 00 00 – Common Work Results for Plumbing
2. Section 22 05 13 – Common Motor Requirements for Plumbing Equipment
3. Section 22 05 16 – Expansion Fittings and Loops for Plumbing Piping
4. Section 22 05 17 – Sleeves and Sleeve Seals for Plumbing
5. Section 22 05 18 – Escutcheons for Plumbing Piping
6. Section 22 05 19 – Meter and Gauges for Plumbing
7. Section 22 05 23 – General Duty Valves for Plumbing Piping
8. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
9. Section 22 05 48 – Vibration Controls for Plumbing Piping and Equipment
10. Section 22 05 53 – Identification for Plumbing Piping and Equipment
11. Section 22 07 00 – Plumbing Insulation
12. Section 22 08 00 – Commissioning of Plumbing Systems
13. Section 22 10 00 – Plumbing Equipment
14. Section 22 11 18 – Domestic Water Distribution System
15. Section 22 11 19 – Plumbing Specialties
16. Section 22 13 16 – Sanitary Waste and Vent Piping
17. Section 22 13 19 – Sanitary Waste Piping Specialties
18. Section 22 31 00 – Domestic Water Softeners
19. Section 22 34 00 – Domestic Water Heaters
20. Section 22 40 00 – Plumbing Fixtures

B. Alternates: None.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.4 SUMMARY

A. This Section includes the following domestic water piping specialties:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated water mixing valve stations.
6. Electronic water mixing valve stations.
7. Strainers.
8. Hose bibbs.
9. Wall hydrants.
10. Drain valves.
11. Water hammer arresters.
12. Trap-seal primer valves.

B. Related Sections include the following:

1. Division 21 sections where water supply to fire suppression systems is required.
2. See all other Division 22 Sections.

1.5 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.6 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

C. Operation and maintenance data.

D. At closeout, Northwestern University Maintenance Requirement Forms, see Division 01 for more information.

1.7 QUALITY ASSURANCE

A. Comply with California Health and Safety Code 116875 (AB 1953) - 2010, for 25% low lead content of piping, pipe fittings, and faucets for water intended for human consumption, and NSF/ANSI Standard 61, including Annex G-2010 - Drinking Water System Components - Low Lead Content Requirement.

B. Other NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.

1.8 SPECIAL WARRANTIES

A. Five (5) years, see Division 01 for more information.

PART 2 - PRODUCTS

2.1 BACKFLOW PREVENTERS & VACUUM BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by Conbraco, no others allowed.

B. Pipe-Applied, Atmospheric-Type Vacuum Breakers for Plumbing Use:

1. Standard: ASSE 1001.
2. Size: As required to match connected piping.
3. Body: Bronze.
4. Finish: Rough bronze.
5. Lead free NSF/ANSI 61 compliant

C. Intermediate Atmospheric-Vent Backflow Preventers for Vending and Coffee Stations:

1. Standard: ASSE 1012.
2. Operation: Continuous-pressure applications.
3. Body: Bronze.
4. Finish: Rough bronze.
5. Lead free NSF/ANSI 61 compliant

D. Reduced-Pressure-Principle Backflow Preventers for Plumbing Use:

1. The reduced pressure zone assembly shall be C89836 lead-free and consist of two independent torsion spring check modules, a differential pressure relief valve located between and below the two modules, two drip tight shutoff valves, and required

torsion spring check modules and relief valve shall be contained with a sleeve accessible single housing constructed from stainless steel in sizes 2.5" -8", and from FDA epoxy coated ductile iron for 10" and 12" sizes. Provide with NRS gate or OSY gate valves with either flanged or grooved end pipe connections on larger sizes, but smaller sizes to have ball valves with stainless balls and stems if available. Butterfly valves are not acceptable.

2. Torsion spring checks shall have replaceable chloramine resistant silicone discs and in operation, produce drip tight closure against the reverse flow of liquid caused by backpressure or back-siphonage.
3. ASSE 1047 approved.
4. Basis of Design - Conbraco RPDALF4 .

E. Reduced Pressure Detector Backflow Preventers for Supply of Fire Suppression Systems:

1. See applicable Division 21 sections. Backflow preventers for supply of fire suppression systems are furnished and installed by the project Plumbing Contractor. Conbraco only for manufacturer.

F. Backflow-Preventer Test Kits:

1. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test- procedure instructions.

2.2 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Conbraco

2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Body: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
5. Valves for Dishwasher Booster Heater Water Supplies: Include integral bypass.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Lead free NSF/ANSI 61 compliant

2.3 BALANCING VALVES

A. Memory-Stop Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of

the following:

a. Conbraco

2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.
10. Handle: Vinyl-covered steel with memory-setting device.
11. Lead free NSF/ANSI 61 compliant

2.4 TEMPERATURE-ACTUATED WATER MIXING VALVE STATIONS

A. Primary, Thermostatic, Water Mixing Valve Stations:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Holby.
b. Or approved equal.

2. Description: Complete factory preassembled, high/low, ASSE 1017, lead free, water temperature control station mounted on heavy duty welded strut frame for wall mounting including piping, valving, and gages.

a. Type: Exposed-mounting, thermostatically controlled water mixing valve assembly.
b. Materials: Bronze body with corrosion-resistant interior components, and copper piping.
c. Connections: Threaded or soldered.
d. Accessories/features: Manual adjustments, bi-metal thermostat, color coded dials, locking temperature regulating valves, adjustable limit stops, check stops on hot- and cold-water supplies, outlet ball valves, factory tested, and temperature gauge.
e. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
f. Tempered-Water Design Flow Rate: See drawings.
g. Valve Finish: Rough bronze.
h. Controls: Aquastat and wiring box including red and green operating lights, GFCI switch.
i. If called for on drawings, provide with stainless steel cabinet, building management system interface, and/or test connection piping on outlet.
j. Install a valved bypass around mixing assembly.

k. Lead free NSF/ANSI 61 compliant

2.5 ELECTRONIC WATER MIXING VALVE STATIONS, IF SPECIFIED

A. Primary, Thermostatic, Water Mixing Valve Stations:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armstrong Brain.
b. Or approved equal.

2. Description: Complete factory preassembled, high/low, ASSE 1017, lead free, water temperature control station mounted on heavy duty welded strut frame for wall mounting including piping, valving, and gages.

a. Type: Exposed-mounting, thermostatically controlled water mixing valve assembly.
b. Materials: Bronze body with corrosion-resistant interior components, and copper piping.
c. Connections: Threaded or soldered.
d. Accessories/features: Manual adjustments, bi-metal thermostat, color coded dials, locking temperature regulating valves, adjustable limit stops, check stops on hot- and cold-water supplies, outlet ball valves, factory tested, and temperature gauge.
e. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
f. Tempered-Water Design Flow Rate: See drawings.
g. Valve Finish: Rough bronze.
h. Controls: Aquastat and wiring box including red and green operating lights, GFCI switch.
i. If called for on drawings, provide with stainless steel cabinet, building management system interface, and/or test connection piping on outlet.
j. Install a valved bypass around mixing assembly.
k. Lead free NSF/ANSI 61 compliant

2.6 HOSE BIBBS

A. Hose Bibbs (HB):

1. Manufacturers: Subject to compliance with requirements, provide the product indicated on the drawings or a comparable product by one of the following:

a. Chicago.
b. Arrowhead Brass Products, Inc.

c. Woodford Manufacturing Company.

2. Description:

a. Standard: ASME A112.18.1 for sediment faucets.
b. Body Material: Bronze.
c. Seat: Bronze, replaceable.
d. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
e. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
f. Finish: Chrome plated.

2.7 WALL HYDRANTS

A. Non-Freeze Wall Hydrants (WH):

1. Manufacturers: Subject to compliance with requirements, provide the product indicated on the drawings or a comparable product by one of the following:

a. Josam Company.
b. Smith, Jay R. Mfg. Co.
c. Tyler Pipe; Wade Division.
d. Zurn Plumbing Products Group.

2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key. (One with each wall hydrant.)
5. Casing and Operating Rod: Of length required to match wall thickness with wall clamp.
6. Inlet: NPS 3/4.
7. Outlet: Concealed, with integral vacuum breaker and ASME B1.20.7 garden-hose thread.
8. Box: Deep, flush mounting with polished nickel bronze cover

2.8 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco.

2. Standard: MSS SP-110 for standard-port, two-piece ball valves.
3. Size: NPS 3/4.

4. Ball: Chrome-plated brass.
5. Seats and Seals: Replaceable.
6. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.9 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Josam Company.
   b. PPP Inc.
   c. Smith, Jay R. Mfg. Co.
   d. Zurn Plumbing Products Group.

2. Description:

   a. Standard: ASSE 1010 or PDI-WH 201.
   b. Type: Metal bellows.
   c. Size: In accordance with PDI-WH 201.

2.10 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. PPP Inc.
   b. Smith, Jay R. Mfg. Co.
   c. Watts Industries

2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.11 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron, FDA-approved, with epoxy coating for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:

   a. Strainers NPS 2 and Smaller: 0.020 inch.
   b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
   c. Strainers NPS 5 and Larger: 0.10 inch.

6. Drain: Pipe plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
3. Do not install bypass piping around backflow preventers.
4. At domestic water services 3" and larger that contain a backflow preventer shall have two backflows for redundancy.

C. Install water pressure regulators with inlet and outlet shutoff valves and bypass with memory- stop balancing valve. Install pressure gages on inlet and outlet.

D. Install balancing valves in locations where they can easily be adjusted.

E. Install temperature-actuated water mixing valve stations in accordance with manufacturer's instructions.

F. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.

G. Install water hammer arresters in water piping according to PDI-WH 201.

H. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

I. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

J. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each reduced-pressure-principle backflow preventer and double-check backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.3 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
1. Provide Payment and Performance Bonds for the full value of their Subcontract.
2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
1. Comply with the Instructions to Bidders.
2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
FILED SUBCONTRACTOR'S BID FOR SECTION:
22 13 16 – SANITARY WASTE AND VENT PIPING

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
1. All subcontractors to the Filed Subcontractor, whose work is:
a. Valued at $10,000 or more.
2. The contract sum for each subcontractor required to be listed.
a. An affidavit that all subcontractors named on the Filed Subcontractor's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
4. Comply with the applicable New York General Laws and the following:
a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the

Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None.	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. P0.01 – Plumbing Schedules and Details
2. P0.02 – Plumbing Notes
3. P0.03 – SMT Rough-In Details
4. P0.04 – Sanitary Waste and Natural Gas Riser Diagrams
5. P1.01 – Sanitary Plan
6. P2.01 – Water Piping Plan
7. P3.01 – Natural Medical/Gas and Storm Drainage Plan
8. P3.02 – Roof Natural Gas and Storm Drainage Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 22 00 00 – Common Work Results for Plumbing
2. Section 22 05 13 – Common Motor Requirements for Plumbing Equipment
3. Section 22 05 16 – Expansion Fittings and Loops for Plumbing Piping
4. Section 22 05 17 – Sleeves and Sleeve Seals for Plumbing
5. Section 22 05 18 – Escutcheons for Plumbing Piping
6. Section 22 05 19 – Meter and Gauges for Plumbing
7. Section 22 05 23 – General Duty Valves for Plumbing Piping
8. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
9. Section 22 05 48 – Vibration Controls for Plumbing Piping and Equipment
10. Section 22 05 53 – Identification for Plumbing Piping and Equipment
11. Section 22 07 00 – Plumbing Insulation
12. Section 22 08 00 – Commissioning of Plumbing Systems
13. Section 22 10 00 – Plumbing Equipment
14. Section 22 11 18 – Domestic Water Distribution System
15. Section 22 11 19 – Plumbing Specialties
16. Section 22 13 16 – Sanitary Waste and Vent Piping
17. Section 22 13 19 – Sanitary Waste Piping Specialties
18. Section 22 31 00 – Domestic Water Softeners
19. Section 22 34 00 – Domestic Water Heaters
20. Section 22 40 00 – Plumbing Fixtures

B. Alternates: None.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.4 SUMMARY .03

A. This Section includes sanitary drainage inside the building up to a point 5'-0" outside the building and vent piping inside the building including:

1. Pipe and fittings.
2. Special pipe fittings.

1.5 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.6 SUBMITTALS

A. Field quality-control inspection and test reports.

1.7 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-DWV" for plastic drain, waste, and vent piping; and "NSF-drain" for plastic drain piping.

1.8 FIELD CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify the University no fewer than seven days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without the University's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Hub-and-Spigot, Cast-Iron Pipe and Fittings: ASTM A 74, Service class.

1. Gaskets: ASTM C 564, rubber.

B. Hubless Cast-Iron Pipe and Fittings: ASTM A 888 or CISPI 301.

1. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion- resistant fasteners, and rubber sleeve with integral, center pipe stop.

a. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
b. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.

C. Schedule 40 PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.

1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.
2. Solvent Cement and Adhesive Primer:

a. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, Schedule 40, galvanized. Include ends matching joining method.

1. Drainage Fittings: ASME B16.12, galvanized, threaded, cast-iron drainage pattern.
2. Pressure Fittings:

a. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.
b. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball- and-socket, metal-to-metal, bronze seating surface; and female threaded ends.
c. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.

d. Cast-Iron Flanges: ASME B16.1, Class 125.
e. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125, galvanized.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Special pipe fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.

B. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

C. Aboveground, soil & waste piping shall be:

1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.

D. Aboveground, vent piping shall be one of the following:

1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.
2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

E. Underground, soil, waste, and vent piping shall be one of the following:

1. Service class, hub-and-spigot, cast-iron soil pipe and fittings; gaskets; and compression joints.
2. Solid-wall Schedule 40 PVC pipe, PVC socket fittings, and solvent-cemented joints.

F. Sewage pump or sump pump discharge piping shall be one of the following:

1. Solid-wall Schedule 40 PVC pipe, PVC socket fittings, and solvent-cemented joints.
2. Schedule 40 galvanized steel pipe with screwed galvanized cat iron drainage fittings.

G. Single-Wall, Chemical-Waste Sewerage Piping: Use the following piping materials for each size range:

1. NPS 1-1/2 to NPS 4 (DN 40 to DN 100): CPVC drainage pipe and fittings and solvent-cemented joints.

H. Underground, Double-Containment, Chemical-Waste Sewerage Piping: Use the following piping materials for each size range:

1. NPS 2 to NPS 12 (DN 50 to DN 300): CPVC double-containment drainage pipe and fittings.

I. Aboveground Chemical-Waste Piping: Use the following piping materials for each size range:

1. NPS 1-1/2 to NPS 6 (DN 40 to DN 150): CPVC drainage piping and solvent-cemented joints.

J. PVC piping may **not** be installed in a return air plenum for any of the above piping applications unless piping is completely insulated in fire retardant insulation rated for return air plenums.

3.3 PIPING INSTALLATION

A. Site sanitary sewer piping to a point 5’-0” outside the building is specified in Division 33 Section "Facility Sanitary Sewers."

B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

C. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

D. Install CPVC drainage piping according to ASTM D 2321 and ASTM F 1668.

E. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

F. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

G. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Sanitary Drains: 2 percent downward in direction of flow for piping NPS 2 and 1 percent downward in direction of flow for piping NPS 3 and larger.
2. Vent Piping: Slope toward vertical fixture vent or toward vent stack.

H. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

I. Install PVC soil and waste drainage and vent piping according to ASTM D 2665 and ASTM D 2321.

J. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

K. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Common Work Results for Plumbing".

L. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Common Work Results for Plumbing".

M. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Common Work Results for Plumbing".

3.4 VALVE INSTALLATION

A. General-duty valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

B. Shutoff Valves: Install shutoff valve on each sewage pump or sump pump discharge.

C. Check Valves: Install swing check valve, downstream from shutoff valve, on each sewage pump or sump pump discharge.

3.5 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
2. Hubless Joints: Make with rubber gasket and sleeve or clamp.

C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.6 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

C. Support vertical piping and tubing at base and at each floor.

D. Install piping hangers and rod diameters per MSS-SP-69

E. Install supports for vertical cast-iron soil piping every 15 feet.

F. Install supports for vertical steel piping every 15 feet.

G. Install supports for vertical CPVC piping every 48 inches.

H. Install supports for vertical PVC piping every 48 inches.

I. Support piping and tubing according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

B. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Sanitary Waste Piping

Specialties."

2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Sanitary Waste Piping Specialties."
4. Equipment: Connect drainage piping or pump discharge piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures. Inspections shall be made by FMO plumbing staff prior to closing-in of walls.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test drainage piping on completion of roughing in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

3.9 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.10 PROTECTION

A. Exposed PVC Piping: Protect PVC piping exposed to sunlight with two coats of water-based latex paint.

END OF SECTION

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
1. Provide Payment and Performance Bonds for the full value of their Subcontract.
2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
1. Comply with the Instructions to Bidders.
2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
FILED SUBCONTRACTOR'S BID FOR SECTION:
22 13 19 – SANITARY WASTE PIPING SPECIALTIES

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
1. All subcontractors to the Filed Subcontractor, whose work is:
a. Valued at $10,000 or more.
2. The contract sum for each subcontractor required to be listed.
a. An affidavit that all subcontractors named on the Filed Subcontractor's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
4. Comply with the applicable New York General Laws and the following:
a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the

Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None.	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. P0.01 – Plumbing Schedules and Details
2. P0.02 – Plumbing Notes
3. P0.03 – SMT Rough-In Details
4. P0.04 – Sanitary Waste and Natural Gas Riser Diagrams
5. P1.01 – Sanitary Plan
6. P2.01 – Water Piping Plan
7. P3.01 – Natural Medical/Gas and Storm Drainage Plan
8. P3.02 – Roof Natural Gas and Storm Drainage Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 22 00 00 – Common Work Results for Plumbing
2. Section 22 05 13 – Common Motor Requirements for Plumbing Equipment
3. Section 22 05 16 – Expansion Fittings and Loops for Plumbing Piping
4. Section 22 05 17 – Sleeves and Sleeve Seals for Plumbing
5. Section 22 05 18 – Escutcheons for Plumbing Piping
6. Section 22 05 19 – Meter and Gauges for Plumbing
7. Section 22 05 23 – General Duty Valves for Plumbing Piping
8. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
9. Section 22 05 48 – Vibration Controls for Plumbing Piping and Equipment
10. Section 22 05 53 – Identification for Plumbing Piping and Equipment
11. Section 22 07 00 – Plumbing Insulation
12. Section 22 08 00 – Commissioning of Plumbing Systems
13. Section 22 10 00 – Plumbing Equipment
14. Section 22 11 18 – Domestic Water Distribution System
15. Section 22 11 19 – Plumbing Specialties
16. Section 22 13 16 – Sanitary Waste and Vent Piping
17. Section 22 13 19 – Sanitary Waste Piping Specialties
18. Section 22 31 00 – Domestic Water Softeners
19. Section 22 34 00 – Domestic Water Heaters
20. Section 22 40 00 – Plumbing Fixtures

B. Alternates: None.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.4 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Cleanouts.
2. Floor drains.
3. Through penetration firestop assemblies.
4. Roof flashing assemblies.
5. Miscellaneous sanitary drainage piping specialties.
6. Flashing materials.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

1.6 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Company.
2. Smith, Jay R. Mfg. Co.
3. Tyler Pipe; Wade Div.
4. Zurn Plumbing Products Group.

B. Exposed Horizontal Cleanouts, **HCO**:

1. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
2. Size: Same as connected drainage piping
3. Body Material: Hubless, cast-iron soil pipe test tee as required matching connected

piping.

C. Floor Cleanouts, **FCO**:

1. Standard: ASME A112.36.2M for adjustable housing cleanout.
2. Size: Same as connected branch.
3. Coated cast iron internal gasketed ABS cleanout plug and adjustable ABS housing.
4. Medium-duty scoriated secured round satin finish Nikaloy top.

D. Wall Cleanouts, **WCO**:

1. Standard: ASME A112.36.2M. Include wall access.
2. Size: Same as connected drainage piping.
3. Round stainless steel wall access cover with screw and no-hub cleanout.

2.2 FLOOR DRAINS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Company.
2. Smith, Jay R. Mfg. Co.
3. Tyler Pipe; Wade Div.
4. Zurn Plumbing Products Group.

B. Floor Drains:
1. Standard: ASME A112.6.3.
2. Body Material: Coated cast iron.
3. Bottom Outlet with Seepage & Anchor Flange with clamping device.
4. Strainer: 6” Round Nickel bronze, Light Duty.

2.3 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Refer to Firestopping and Fireproofing specifications for requirements.

2.4 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Acorn Engineering Company; Elmdor/Stoneman Div.
b. Thaler Metal Industries Ltd.

B. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch- thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

a. NPS 2: 4-inch- minimum water seal.
b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

B. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

C. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.

2.6 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Fasteners: Metal compatible with material and substrate being fastened.

C. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

D. Solder: ASTM B 32, lead-free alloy.

E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 100 feet.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1- inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.

4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

H. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.

I. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

J.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to applicable Division 07 Section.

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

3.4 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each grease interceptor.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.5 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 223100 – DOMESTIC WATER SOFTENERS

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
   1. Provide Payment and Performance Bonds for the full value of their Subcontract.
   2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
   1. Comply with the Instructions to Bidders.
   2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
   3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
   4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
      FILED SUBCONTRACTOR'S BID FOR SECTION:
      22 31 00 – DOMESTIC WATER SOFTENERS

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
   1. All subcontractors to the Filed Subcontractor, whose work is:
      a. Valued at $10,000 or more.
   2. The contract sum for each subcontractor required to be listed.
      a. An affidavit that all subcontractors named on the Filed Subcontractor's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
   3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
   4. Comply with the applicable New York General Laws and the following:
      a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the

Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None.	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. P0.01 – Plumbing Schedules and Details
2. P0.02 – Plumbing Notes
3. P0.03 – SMT Rough-In Details
4. P0.04 – Sanitary Waste and Natural Gas Riser Diagrams
5. P1.01 – Sanitary Plan
6. P2.01 – Water Piping Plan
7. P3.01 – Natural Medical/Gas and Storm Drainage Plan
8. P3.02 – Roof Natural Gas and Storm Drainage Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 22 00 00 – Common Work Results for Plumbing
2. Section 22 05 13 – Common Motor Requirements for Plumbing Equipment
3. Section 22 05 16 – Expansion Fittings and Loops for Plumbing Piping
4. Section 22 05 17 – Sleeves and Sleeve Seals for Plumbing
5. Section 22 05 18 – Escutcheons for Plumbing Piping
6. Section 22 05 19 – Meter and Gauges for Plumbing
7. Section 22 05 23 – General Duty Valves for Plumbing Piping
8. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
9. Section 22 05 48 – Vibration Controls for Plumbing Piping and Equipment
10. Section 22 05 53 – Identification for Plumbing Piping and Equipment
11. Section 22 07 00 – Plumbing Insulation
12. Section 22 08 00 – Commissioning of Plumbing Systems
13. Section 22 10 00 – Plumbing Equipment
14. Section 22 11 18 – Domestic Water Distribution System
15. Section 22 11 19 – Plumbing Specialties
16. Section 22 13 16 – Sanitary Waste and Vent Piping
17. Section 22 13 19 – Sanitary Waste Piping Specialties
18. Section 22 31 00 – Domestic Water Softeners
19. Section 22 34 00 – Domestic Water Heaters
20. Section 22 40 00 – Plumbing Fixtures

B. Alternates: None.

1.3 SUMMARY

A. Section Includes:

1. Commercial water softeners.
2. Chemicals.
3. Water-testing sets.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water softeners.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Wiring Diagrams: For power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

A. Field quality-control reports.

B. Warranty.

C. Operation and maintenance data.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Salt for Brine Tanks: Furnish in same form as and at least four times original load.
2. Store salt on raised platform where directed by Owner. Do not store in contact with concrete floor.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended application.

B. ASME Compliance for Steel Tanks: Fabricate and label mineral tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, where indicated.

C. UL Compliance: Fabricate and label water softeners to comply with UL 979, "Water Treatment Appliances."

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of water softeners that fail in materials or workmanship within specified warranty period.

1. Commercial Water Softeners, Warranty Period: From date of Substantial Completion.

a. Mineral & Brine Tanks: Five years.
b. System and Control Valve: One year.

B. The universal warranty start date is defined in the front end documents.

PART 2 - PRODUCTS

2.1 COMMERCIAL WATER SOFTENERS, AS REQUIRED

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Culligan International Company.
2. Ecodyne Water Treatment, Inc.
3. Kinetico Incorporated.
4. Marley
5. WaterSoft; a division of Amtrol, Inc.

B. Description: Factory-assembled, pressure-type water softener.

1. Furnish and install a water softener to provide a zero soft water effluent as determined by an ASTM standard soap test method, when operated in accordance with operating instructions. Each unit shall be designed to provide X grains per tank maximum capacity of hardness reduction between regenerations at a maximum salt dosage of X lbs. salt. Each unit shall be capable of a continuous flow rate of X GPM with a pressure drop of 15 psi and a peak flow rate of X GPM with a pressure drop of 25 psi.
2. The softener vessel(s) shall be designed for a working pressure of 150 psi and a temperature of 120 degrees F. A minimum freeboard volume of 50% shall be provided to assure adequate bed expansion during backwash. Vessel(s) shall be manufactured of fiberglass reinforced polyester (FRP). The exterior side shall be reinforced by a continuous roving glass filament overwrap of the same color as the

vessel(s) shell. The vessel(s) shall be supported by a molded polypropylene structural base.

3. The backwash distributor and soft water collector shall be of the hub-radial design and shall require only assembly of the riser pipe upon installation. The radials shall be designed with a higher density of slots at the outer ends to provide adequate distribution and collection of water away from the center of the tank. Internal piping material shall be constructed of PVC and/or ABS plastic. Systems shall have a single point distributor.
4. The softener shall be provided with X cubic feet of high-capacity, non-phenolic resin per vessel(s) having a minimum exchange of capacity of X grains per cubic foot when regenerated with X lbs. of salt per cubic foot. The media shall be solid, of the proper particle size (not more than 4% through 40 mesh U.S. standard screen, wet screening) and shall contain no plates, shells, agglomerates or other shapes which might interfere with the normal function of the water softener.
5. The combination salt storage and brine measuring tank with cover shall be sized to hold X lbs. of salt. The tank shall be of rotationally molded rigid polyethylene. The brine tank shall be equipped with an elevated salt plate for the collection of brine and shall have a chamber to house a brine valve assembly. The brine valve assembly shall include an automatic air eliminator and safety float shut-off valve. It shall open automatically, to educt brine, close to prevent the entrance of air after the brine has been drawn, and permit refill of the tank with the correct amount of water. Brine dosage shall be controlled by the softener control valve through an adjustment on the clock timer. The system shall be designed to allow proper refilling regardless of the salt level in the tank.

6. Controls: Fully automatic; factory wired and factory mounted on unit.

    a. Adjustable duration of various regeneration steps.
    b. Push-button start and complete manual operation.
    c. Twin Alternating Control – The regeneration shall be controlled by a mechanically operated automatic reset water meter installed in the common soft water effluent line. Softeners shall be regenerated based on total gallons through the meter. An alternator shall be supplied to allow only one unit to be in regeneration or standby at a time while the other unit is in-service. This system shall provide a continuous supply of soft water. Indicating lights shall be provided to show which unit is in- service and which one is regenerating
    d. Sequence of Operation: Multiport pilot-control valve automatically pressure- actuates main operating valve through steps of regeneration and return to service.
    e. Pointer on pilot-control valve shall indicate cycle of operation.
    f. Includes means of manual operation of pilot-control valve if power fails.

7. Main Operating Valves: Industrial, automatic, multiport, diaphragm type with the following features:

a. X inch inlet and outlet connections
b. Constructed of lead-free brass.
c. Mechanically actuated, four position type to accomplish the regeneration steps of backwash, brine draw / slow rinse, fast rinse and brine tank refill.
d. The valve shall contain a fixed orifice eductor nozzle and self-adjusting backwash flow control.
e. Slow opening and closing, non-slam operation.
f. Diaphragm guiding on full perimeter from fully open to fully closed.
g. Self-adjusting, internal, automatic brine injector that draws brine and rinses at constant rate independent of pressure.
h. Sampling cocks for soft water.
i. Special tools are not required for service.

8. Flow Control: Automatic, to control backwash and flush rates over wide variations in operating pressure; does not require field adjustments.

a. Demand-Initiated Control: Each mineral tank of twin mineral-tank unit is equipped with automatic-reset-head water meter that electrically activates cycle controllers to initiate regeneration at preset total in gallons. Head automatically resets to preset total in gallons for next service run. Electrical lockout prevents simultaneous regeneration of both tanks.

9. Factory-Installed Accessories:

a. Piping, valves, tubing, and drains.
b. Sampling cocks.
c. Main-operating-valve position indicators.
d. Water meters.

C. Capacities and Characteristics:

1. Water Analysis:

a. Hardness: X grains/gal.
b. Inlet Water Pressure: X psig
c. Water Temperature: X deg F

2. Continuous Service Flow Rate: X gpm at 15-psig pressure drop.
3. Peak Service Flow Rate: X gpm at 25-psig pressure drop.
4. Water Meter Size: X”
5. Manifold Pipe Size: X”
6. Water Consumption: X gal./day
7. Number of Mineral Tanks: Two.
8. Mineral Quantity, Each Tank: X cu. ft.
9. Mineral Exchange Capacity: X grains per cubic foot
10. Electrical Characteristics: 24 Volt

11. Salt Capacity: X lbs

2.2 CHEMICALS

A. Mineral: High-capacity, sulfonated-polystyrene, ion-exchange resin that is stable over entire pH range with good resistance to bead fracture from attrition or shock.

1. Exchange Capacity: X grains/cu. ft. of calcium carbonate of resin when regenerated with X lb of salt.

B. Salt for Brine Tanks: High-purity sodium chloride, free of dirt and foreign material. Rock and granulated forms are unacceptable.

2.3 WATER-TESTING SETS

A. Description: Manufacturer's standard water-hardness testing apparatus and chemicals with testing procedure instructions. Include metal container suitable for wall mounting.

PART 3 - EXECUTION

3.1 WATER SOFTENER INSTALLATION

A. Equipment Mounting:

1. Install commercial water softeners on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."

B. Install brine lines and fittings furnished by equipment manufacturer but not specified to be factory installed.

C. Prepare mineral-tank distribution system and underbed for minerals and place specified mineral into mineral tanks.

D. Install water-testing sets mounted on wall, unless otherwise indicated, and near water softeners.

E. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where piping is installed adjacent to equipment, allow space for service and maintenance of equipment.

C. Install shutoff valves on raw-water inlet and soft-water outlet piping of each mineral tank.

1. Metal general-duty valves are specified in Section 220523 "General-Duty Valves for Plumbing Piping."
2. Exception: Water softeners with factory-installed shutoff valves at locations indicated.

D. Install pressure gages on raw-water inlet and soft-water outlet piping of each mineral tank. Pressure gages are specified in Section 220519 "Meters and Gages for Plumbing Piping."

1. Exception: Water softeners with factory-installed pressure gages at locations indicated.

E. Install valved bypass in water piping around water softeners.

1. Metal general-duty valves are specified in Section 220523 "General-Duty Valves for Plumbing Piping."
2. Water piping is specified in Section 221116 "Domestic Water Piping."

F. Install drains as indirect wastes to spill into open drains or over floor drains.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written

instructions.

B. Add water to brine tanks and fill with the following form of salt:

1. Commercial Water Softeners: The media shall be solid, of the proper particle size (not more than 4% through 40 mesh U.S. standard screen, wet screening) and shall contain no plates, shells, agglomerates or other shapes which might interfere with the normal function of the water softener.

C. Sample water softener effluent after startup and at three consecutive seven-day intervals (total of four samples), and prepare certified test reports for required water performance characteristics. Comply with the following:

1. ASTM D 859, "Test Method for Silica in Water."
2. ASTM D 1067, "Test Methods for Acidity or Alkalinity of Water."
3. ASTM D 1068, "Test Methods for Iron in Water."
4. ASTM D 1126, "Test Method for Hardness in Water."
5. ASTM D 1129, "Terminology Relating to Water."
6. ASTM D 3370, "Practices for Sampling Water from Closed Conduits."

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain water softeners.

END OF SECTION

SECTION 223400 – FUEL FIRED DOMESTIC WATER HEATERS

PART 1 - GENERAL

[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
   1. Provide Payment and Performance Bonds for the full value of their Subcontract.
   2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
   1. Comply with the Instructions to Bidders.
   2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
   3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
   4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
      FILED SUBCONTRACTOR'S BID FOR SECTION:
      22 34 00 – FUEL FIRED DOMESTIC WATER HEATERS

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
   1. All subcontractors to the Filed Subcontractor, whose work is:
      a. Valued at $10,000 or more.
   2. The contract sum for each subcontractor required to be listed.
      a. An affidavit that all subcontractors named on the Filed Subcontractor's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
   3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
   4. Comply with the applicable New York General Laws and the following:
      a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the

Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None.	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. P0.01 – Plumbing Schedules and Details
2. P0.02 – Plumbing Notes
3. P0.03 – SMT Rough-In Details
4. P0.04 – Sanitary Waste and Natural Gas Riser Diagrams
5. P1.01 – Sanitary Plan
6. P2.01 – Water Piping Plan
7. P3.01 – Natural Medical/Gas and Storm Drainage Plan
8. P3.02 – Roof Natural Gas and Storm Drainage Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 22 00 00 – Common Work Results for Plumbing
2. Section 22 05 13 – Common Motor Requirements for Plumbing Equipment
3. Section 22 05 16 – Expansion Fittings and Loops for Plumbing Piping
4. Section 22 05 17 – Sleeves and Sleeve Seals for Plumbing
5. Section 22 05 18 – Escutcheons for Plumbing Piping
6. Section 22 05 19 – Meter and Gauges for Plumbing
7. Section 22 05 23 – General Duty Valves for Plumbing Piping
8. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
9. Section 22 05 48 – Vibration Controls for Plumbing Piping and Equipment
10. Section 22 05 53 – Identification for Plumbing Piping and Equipment
11. Section 22 07 00 – Plumbing Insulation
12. Section 22 08 00 – Commissioning of Plumbing Systems
13. Section 22 10 00 – Plumbing Equipment
14. Section 22 11 18 – Domestic Water Distribution System
15. Section 22 11 19 – Plumbing Specialties
16. Section 22 13 16 – Sanitary Waste and Vent Piping
17. Section 22 13 19 – Sanitary Waste Piping Specialties
18. Section 22 31 00 – Domestic Water Softeners
19. Section 22 34 00 – Domestic Water Heaters
20. Section 22 40 00 – Plumbing Fixtures

B. Alternates: None.

1.3 DESCRIPTION

A. This section describes the requirements for installing a complete gas fired domestic water heating system ready for operation including water heaters, thermometers, and all necessary accessories, connections, and equipment.

1.4 RELATED WORK

A. Preparation and finish painting: Section 09900, PAINTING.

B. Section 15050, BASIC METHODS AND REQUIREMENTS (MECHANICAL).

C. Circulating Pump: Section 15139, PUMPS (PLUMBING).

D. Heater Insulation: Section 15250, INSULATION.

E. Piping, Fittings, Valves and Gages: Section 15400, PLUMBING SYSTEMS.

1.5 SUBMITTALS

A. Submit in one package in accordance with Section 01340, SAMPLES AND SHOP DRAWINGS.

B. Manufacturer's Literature and Data:

1. Heaters.
2. Valves.
3. Thermometers.
4. Gages.
5. Vacuum Breakers and Vacuum Relief Valves.

1.6 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American National Standard Institute (ANSI):

Z21.10.1 ..... Gas Water Heaters

C. American Society of Mechanical Engineers (ASME):

Section IV-95..... Heating Boilers

Section VIII-95..... Pressure Vessels, Division 1

D. Underwriters Laboratories Inc. (UL):

UL-174 ..... Standard for Electrical Storage Water Heater

PART 2 - PRODUCTS

2.1 GAS WATER HEATER

A. Constructed and rated in accordance with American Gas Association Code for testing and rating gas-fired water heaters. ANSI Z21.1.10.1

B. Material: Steel, heavily zinc-coated inside and outside, tested to hydrostatic pressure of 1025 kPa (150 psi).

C. General Features: Equip each heater with brass and copper fittings and snap action or gradual action thermostat. Fit gas supply pipe with a control gas cock between gas cock and burner and provide a suitable safety pilot light, with valved pipe from connection to the outside of thermostatic valve. Provide a combination pressure and temperature relief valve and a thermometer. Provide medium pressure regulator with rating per gas line pressures.

D. Flue: Provide each heater with number 0.85 mm thick (22 gage) galvanized iron flue of same size as heater outlet, extending from heater to chimney if specified**. For direct vented hot water heaters, follow manufacturer's installation instructions and recommendations and local code requirements. Provide all required concentric termination fittings with corrosion resistant screened inlet and outlet.**

E. Temperature Setting: Set thermostat for maximum water temperature of 55 °C (130 °F).

2.2 THERMOMETERS

A. Gas and Electric Water Heaters: Straight stem, iron case, red reflecting mercury thermometer approximately 175 mm (7 inches) high, 4 to 115 °C (40 to 240 °F). Install in hot water pipe close to outlet of tank.

2.3 RELIEF VALVE FOR GAS AND ELECTRIC WATER HEATERS

Brass or bronze, fully automatic, self-closing combination pressure and temperature relief valve. Pressure relief valve shall be spring-operated with testing lever, set at 690 kPa (100 pounds) pressure. Temperature relief valves shall contain a noncorrosive metal thermostat with bulb. Valve shall be tested and approved as to its BTU capacity by ASME or an independent laboratory satisfactory to the Contracting Officer. Pipe discharge to floor drain as shown.

PART 3 - EXECUTION

3.1 LEAKAGE TEST

Before connections are made, test heaters with hydrostatic pressure of 1375 kPa (200 psi) or per manufacturer's requirements and prove tight.

3.2 PERFORMANCE TEST

Prove system is balanced and a minimum of 49 °C (120 °F)**.** and a maximum of 54 °C (130 °F)**.** is available at the most remote outlet from heaters.

END OF SECTION

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
   1. Provide Payment and Performance Bonds for the full value of their Subcontract.
   2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
   1. Comply with the Instructions to Bidders.
   2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
   3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
   4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
      FILED SUBCONTRACTOR'S BID FOR SECTION:
      22 40 00 – PLUMBING FIXTURES

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
   1. All subcontractors to the Filed Subcontractor, whose work is:
      a. Valued at $10,000 or more.
   2. The contract sum for each subcontractor required to be listed.
      a. An affidavit that all subcontractors named on the Filed Subcontractor's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
   3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
   4. Comply with the applicable New York General Laws and the following:
      a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the

Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None.	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. P0.01 – Plumbing Schedules and Details
2. P0.02 – Plumbing Notes
3. P0.03 – SMT Rough-In Details
4. P0.04 – Sanitary Waste and Natural Gas Riser Diagrams
5. P1.01 – Sanitary Plan
6. P2.01 – Water Piping Plan
7. P3.01 – Natural Medical/Gas and Storm Drainage Plan
8. P3.02 – Roof Natural Gas and Storm Drainage Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 22 00 00 – Common Work Results for Plumbing
2. Section 22 05 13 – Common Motor Requirements for Plumbing Equipment
3. Section 22 05 16 – Expansion Fittings and Loops for Plumbing Piping
4. Section 22 05 17 – Sleeves and Sleeve Seals for Plumbing
5. Section 22 05 18 – Escutcheons for Plumbing Piping
6. Section 22 05 19 – Meter and Gauges for Plumbing
7. Section 22 05 23 – General Duty Valves for Plumbing Piping
8. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment
9. Section 22 05 48 – Vibration Controls for Plumbing Piping and Equipment
10. Section 22 05 53 – Identification for Plumbing Piping and Equipment
11. Section 22 07 00 – Plumbing Insulation
12. Section 22 08 00 – Commissioning of Plumbing Systems
13. Section 22 10 00 – Plumbing Equipment
14. Section 22 11 18 – Domestic Water Distribution System
15. Section 22 11 19 – Plumbing Specialties
16. Section 22 13 16 – Sanitary Waste and Vent Piping
17. Section 22 13 19 – Sanitary Waste Piping Specialties
18. Section 22 31 00 – Domestic Water Softeners
19. Section 22 34 00 – Domestic Water Heaters
20. Section 22 40 00 – Plumbing Fixtures

B. Alternates: None.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.4 SUMMARY

A. This Section includes the following:

1. Faucets for lavatories and showers.
2. Flushometers for water closets and urinals.
3. Toilet seats.
4. Protective shielding guards.
5. Fixture supports.
6. Water closets.
7. Urinals.
8. Lavatories.
9. Sinks and sink faucets.
10. Service sinks and faucets.
11. Mop sinks and faucets.
12. Lab faucets.
13. Shower cabinets.
14. Shower receptors.

B. Related Sections include the following:

1. Section 22 1118 "Domestic Water Distribution System."
2. Section 22 2114 "Plumbing Specialties."

1.5 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. FRP: Fiberglass-reinforced plastic.

D. PMMA: Polymethyl methacrylate (acrylic) plastic.

E. PVC: Polyvinyl chloride plastic.

F. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.6 SUBMITTALS

A. Product Data: For each type of product indicated, and including fixture/item dimensions and rough-in dimensions.

C. Shop Drawings: Diagram power, signal, and control wiring, and for fixture supports and carriers.

D. Operation and maintenance data.

E. At closeout, Northwestern University Maintenance Requirement Forms, see Division 01 for more information.

1.7 QUALITY ASSURANCE

A. 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.

B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

D. Comply with California Health and Safety Code 116875 (AB 1953) - 2010, for 25% low lead content of piping, pipe fittings, and faucets for water intended for human consumption, and NSF/ANSI Standard 61, including Annex G-2010 - Drinking Water System Components - Low Lead Content Requirement.

E. Comply with NSF/ANSI 372 - Low Lead Content Verification Requirement

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
2. Stainless-Steel Sinks: ASME A112.19.3.
3. Vitreous-China Fixtures: ASME A112.19.2M.
4. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
5. Water-Closet, Flushometer Tank Trim: ASSE 1037.

H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:

1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
4. Faucets: ASME A112.18.1.
5. Hose-Connection Vacuum Breakers: ASSE 1011.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
8. NSF Potable-Water Materials: NSF 61.
9. Pipe Threads: ASME B1.20.1.
10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
11. Supply Fittings: ASME A112.18.1.
12. Brass Waste Fittings: ASME A112.18.2.

I. Comply with the following applicable standards and other requirements specified for shower faucets:
1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
3. Faucets: ASME A112.18.1.
4. Hand-Held Showers: ASSE 1014.
5. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Manual-Control Antiscald Faucets: ASTM F 444.
8. Pipe Threads: ASME B1.20.1.
9. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
11. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.

J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Manual-Operation Flushometers: ASSE 1037.
4. Plastic Tubular Fittings: ASTM F 409.
5. Brass Waste Fittings: ASME A112.18.2.
6. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

K. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Flexible Water Connectors: ASME A112.18.6.
2. Hose-Coupling Threads: ASME B1.20.7.

3. Off-Floor Fixture Supports: ASME A112.6.1M.
4. Pipe Threads: ASME B1.20.1.
5. Plastic Toilet Seats: ANSI Z124.5-2013.
6. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.8 SPECIAL WARRANTIES

A. Five (5) years, see Division 01 for more information.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. For flushing fixtures, lavatories, showers, service sinks, and mop sinks specified below, subject to compliance with requirements, provide the products indicated in the Fixture Schedule on the drawings, or a comparable product by one of the following:

1. Kohler.
2. American Standard.

B. For Non-Lab duty faucets, subject to compliance with requirements, provide the products indicated in the Fixture Schedule on the drawings, or a comparable product by one of the following:

1. Chicago Faucet.
2. Kohler.
3. Moen.
4. Sloan Valve.

C. For water closet and urinal flushometers, subject to compliance with requirements, provide the products indicated in the Fixture Schedule on the drawings, or a comparable product by one of the following:

1. Moen (preferred).
2. Sloan Valve.

2.2 LAVATORY FAUCETS

A. Lavatory Faucets:

1. Description: Single-control manual mixing valve. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

a. Body Material: Commercial, solid brass.
b. Finish: Polished chrome plate.
c. Maximum Flow Rate: 1.2 gpm.
d. Centers: 4 inches.
e. Mounting: Deck, exposed.
f. Valve Handle: Lever.
g. Inlets: NPS 3/8 tubing, with NPS 1/2 male adaptor.
h. Spout: Rigid type.
i. Spout Outlet: Spray, 1.2 gpm.
j. Operation: Non-compression, manual.
k. Drain: Grid.

B. Lavatory Faucets:

2.3 SHOWER FAUCETS, IF SPECIFIED

A. Shower Faucets:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated the following:

a. Moen Commercial

2. Description: Single-handle pressure-balance valve. Include hot- and cold-water indicators; check stops; and shower head, arm, and flange. Coordinate faucet inlets with supplies and outlet with diverter valve.

a. Valve Body Material: Solid brass.
b. Valve Body Finish: Polished chrome plate.
c. Maximum Flow Rate: 2.5 gpm.
d. Mounting: Concealed.
e. Antiscald Device: Integral with mixing valve.
f. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
g. Supply Connections: 1/2" NPT.
h. Shower Head Type: Ball standard institutional showerhead with mounting flange.
i. Shower Head Material: Chrome plated brass arm with stainless steel wall flange.
j. Spray Pattern: Adjustable.
k. Integral Volume Control: Not required.
l. Shower-Arm Flow-Control Fitting: 1.5 gpm.

B. Shower Faucets:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated by the following:

a. Moen Commercial

2. Description: Prefabricated stainless steel shower unit with a single-handle pressure-balance valve. Include hot- and cold-water indicators; check stops; and shower head, arm, and flange, and hand held shower with 24" slide bar.

a. Valve Body Material: Solid brass.
b. Valve Body Finish: Polished chrome plate.
c. Shroud: 18 gage stainless steel brushed finish with extension to conceal piping thru ceiling.
d. Maximum Flow Rate: 2.0 gpm.
e. Mounting: Exposed.
f. Backflow Protection Device for Hand-Held Shower: Required.
g. Antiscald Device: Integral with mixing valve.
h. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
i. Supply Connections: Sweat.
j. Shower Head Type: Ball joint and head integral with mounting flange and hand held, slide-bar mounted spray head.
k. Shower Head Material: Metallic with chrome-plated finish.
l. Spray Pattern: Adjustable.
m. Diverter Valve: Required.
n. Integral Volume Control: Not required.
o. Shower-Arm Flow-Control Fitting: 1.5 gpm.

2.4 FLUSHOMETERS

A. Water Closet Flushometers:

1. Description: Exposed, manual, piston type flushometer for water-closet-type fixture. Include brass body with corrosion-resistant internal components, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.

a. Internal Design: Piston operation.
b. Style: Exposed.
c. Inlet Size: NPS 1.
d. Trip Mechanism: Manual.
e. Consumption: 1.6 gal/flush.
f. Tailpiece Size: NPS 1-1/2 and standard length to top of bowl.

2.5 TOILET SEATS

A. Toilet Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. American Standard.
    b. Bemis Manufacturing Company, Duraguard (Basis of Design).
    c. Church Seats.
    d. Olsonite Corp.
    e. Kohler

2. Description: Toilet seat for water-closet-type fixture, heavy duty commercial.

    a. Material: Molded, solid plastic with antimicrobial agent.
    b. Configuration: Open front without cover.
    c. Size: To fit bowl.
    d. Hinge Type: Self-sustaining.
    e. Class: Heavy-duty commercial.
    f. Color: White.
    g. Fasteners: 300 series stainless steel.

2.6 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Plumberex Specialty Products Inc.
    b. TRUEBRO, Inc.
    c. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.7 FIXTURE SUPPORTS

A. Manufacturers for Water Closet Supports: Subject to compliance with requirements, provide products by one of the following:

1. Josam Company
2. Smith, Jay R. Mfg. Co.
3. Tyler Pipe; Wade Div.
4. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Water-Closet Supports:

1. Description: Combination carrier designed for accessible or standard mounting as indicated on drawings, for height of wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space. Carrier must meet the 500 lb. minimum load bearing requirements of ASME A112.19.2-2005/CSA B45.1-05.

C. Urinal Supports:

1. Description: Wall plate.

D. Lavatory Supports:

1. Description: Wall plate.

E. Water Cooler Supports:

1. Wall plates.

2.8 WATER CLOSETS

A. Water Closets:

1. Description: Accessible, floor-mounting, bottom outlet, vitreous-china fixture designed for flushometer valve operation.

a. Bowl Type: Elongated with siphon-jet design. Include bolt caps matching fixture.
b. Surface: Antimicrobial surface which inhibits the growth of stain and odor causing bacteria.
c. Height: ADA.
d. Design Consumption: 1.6 gal/flush.
e. Color: White.
f. Basis of Design: Kohler K-96057-0"Highcrest" model

2.9 LAVATORIES

A. Lavatories:

1. Description: Accessible, wall mounted, vitreous-china fixture.

a. Type: Wall mounted with front overflow and backsplash.
b. Faucet Hole Punching: 4 inch centers or 8 inch centers.
c. Color: White.
d. Supplies: 3/8 inch chrome-plated copper with stops.
e. Drain: Grid
f. Drain Piping: 1-1/4 by 1-1/2 inch chrome-plated, cast-brass P-trap; 1-1/2 inch, 0.045-inch- thick tubular brass waste to wall; and wall escutcheon.
g. Fixture Support: Required.
h. Protective Shielding Guards: Required.

2.10 SINKS

A. Sinks:

1. Subject to compliance with requirements, provide the product indicated in the Fixture Schedule on the drawings or a comparable product by one of the following:

a. Elkay.
b. Just Manufacturing Company.
c. Moen Commercial

2. Description: One or Two-bowl, as indicated below or as scheduled, counter-mounted, self rimming stainless-steel sink.

a. Metal Thickness: 18 gauge Type 304 stainless steel.
b. Drain: 3-1/2-inch crumb cup strainers centered in bowls.
c. Sink Faucet: Polished chrome plated body, gooseneck swing spout, lever handles, ADA design, and 1.5 GPM aerator.
d. Faucet Hole Punching: 4 inch centers or 8 inch centers.
e. Supplies: ½ inch chrome-plated copper with stops.
f. Drain Piping: 1½ inch chrome-plated, cast-brass P-trap; 0.045 inch thick tubular brass waste to wall, and wall escutcheon.

2.11 SERVICE SINKS

A. Service Sinks:

1. Description: Trap-standard- and wall-mounting, enameled, cast-iron fixture with roll-rim two faucet holes in back and rim guard on front and sides.
a. Color: White.
b. Faucet: Sink mount utility type with lever handles, bucket hook, stops, vacuum breaker, spout support, and polished chrome finish. Chicago Faucet (preferred), or approved equal. No threads allowed spouts.
c. Drain: Grid with NPS 3 outlet.
d. Trap Standard: NPS 3 enameled, cast iron with cleanout and floor flange.

e. Fixture Support: Wall hanger furnished with sink.

2.12 MOP SINKS

A. Mop Sinks:

1. Description: Floor mounted, corner type enameled, terrazzo or fiberglass fixture with vinyl rim guard.

a. Size: 24 by 24 inches (minimum).
b. Color: White.
c. Faucet: Wall mount type with polished chrome finish, wall brace, vacuum breaker, lever handles, and stops.
d. Drain: Grid with NPS 3 outlet.
e. Basis of Design: Moen faucet, hose and mop bracket, integral checks, and stainless steel wall guards. No threads allowed on spouts.

2.13 SHOWER CABINETS, IF SPECIFIED

A. Shower Cabinets**:**

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated in the Fixture Schedule on the drawings or a comparable product by one of the following:

a. Fiat.
b. Florestone.
c. Stern-Williams

2. Description: Single access front opening cabinet with terrazzo base, soap dish, curtain rod, and curtain.

a. Floor: Terrazzo.
b. Surround: Galvanized steel insulated sandwich panels with baked enamel finish.
c. Color: White.
d. Drain Location: Center.
e. Drain: 2 inch stainless steel with grid strainer.
f. Faucet and Head: Chrome plated single lever pressure balanced mixing valve with concealed check stops, bent arm and 1.5 GPM shower head.

B. Shower Cabinets:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated in the Fixture Schedule on the drawings or a comparable product by one of the following:

a. Fiat.
b. Florestone.
c. Stern-Williams.

2. Description: Barrier-free ADA compliant shower cabinet with terrazzo base, soap dish, curtain rod, and weighted curtain.

a. Floor: Terrazzo.
b. Surround: Galvanized steel insulated sandwich panels with baked enamel finish.
c. Color: White.
d. Drain Location: Center.
e. Drain: 2 inch stainless steel with grid strainer.
f. Faucet: Chrome plated single lever pressure balanced mixing valve with concealed check stops.
g. ADA Options:

1) Horizontal corner and vertical stainless steel grab bars.
2) Folding wheelchair transfer seat.
3) Wall hung shower head with 24 inch slide bar, stainless steel hose, and inline vacuum breaker.

h. Seat and Shower Head Locations: As indicated on the drawings.

2.14 SHOWER RECEPTORS, IF SPECIFIED

A. Shower Receptors**:**

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated in the Fixture Schedule on the drawings or a comparable product by one of the following:

a. Fiat.
b. Florestone.
c. Stern-Williams.

2. Description: Precast-terrazzo base for field built shower walls.

a. Type: Standard with 4 inch high shoulders and rabbets where called for in schedule on the drawings.
b. Color: White.
c. Drain: Cast-in stainless steel 2 inch drain body with removable grid strainer.
d. Drain Location: Center.

B. Shower Receptors**:**

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated in the Fixture Schedule on the drawings or a comparable product by one of the following:

    a. Fiat.
    b. Florestone.
    c. Stern-Williams.

2. Description: Wheelchair accessible Precast-terrazzo base for field built shower walls.

    a. Type: ADA compliant with 4 inch high shoulders on three sides and entrance arranged for 2” floor depression.
    b. Color: White.
    c. Drain: Cast-in stainless steel 2 inch drain body with removable strainer.
    d. Drain Location: Center.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-mounting fixtures with tubular waste piping attached to supports.

F. Install fixtures level and plumb according to roughing-in drawings.

G. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

I. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

J. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

K. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

L. Install toilet seats on water closets.

M. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

N. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

O. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

P. Install shower flow-control fittings with specified maximum flow rates in shower arms.

Q. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

R. Install escutcheons at piping wall and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Escutcheons for Plumbing Piping."

S. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms.

3.4 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 22 40 00

SECTION 230000 – COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
   1. Provide Payment and Performance Bonds for the full value of their Subcontract.
   2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
   1. Comply with the Instructions to Bidders.
   2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
   3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
   4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
      FILED SUBCONTRACTOR'S BID FOR SECTION:
      23 00 00 – COMMON WORK RESULTS FOR HVAC

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
   1. All subcontractors to the Filed Subcontractor, whose work is:
      a. Valued at $10,000 or more.
   2. The contract sum for each subcontractor required to be listed.
      a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
   3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
   4. Comply with the applicable General Laws and the following:
      a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

	Class of Work	Specification section number and name
a.	None.	None.

A. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. M1.00 – Mechanical Notes
2. M1.01 – Mechanical Details
3. M1.02 – Mechanical Specifications
4. M1.03 – Mechanical Zoning Plan
5. M2.00 – Mechanical Floor Plan
6. M2.01 – Mechanical Ventilation/Heating Plan
7. M2.02 – Mechanical Roof Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 23 00 00 – Common Work Results for HVAC
2. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
3. Section 23 05 48 – Vibration and Controls for HVAC Piping and Equipment
4. Section 23 05 53 – Identification for HVAC Piping and Equipment
5. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
6. Section 23 07 13 – Duct Insulation
7. Section 23 08 00 – Commissioning of HVAC
8. Section 23 09 00 – Instrumentation and Controls for HVAC
9. Section 23 31 13 – Metal Ducts
10. Section 23 33 00 – Air Duct Accessories
11. Section 23 34 23 – HVAC Power Ventilators
12. Section 23 37 13 – Diffusers, Registers, and Grilles
13. Section 23 37 23 – HVAC Gravity Ventilators
14. Section 23 34 00 – Particulate Air Filtration
15. Section 23 72 00 – Air-to-Air Energy Recovery Ventilator
16. Section 23 74 16 – Package Rooftop Air Conditioning Units
17. Section 23 82 39 – Unit Heaters

B. Alternates: None.

1.3 SUMMARY

A. The 00.72.00 Conditions of the Contract and all sections of Division 01, General Requirements shall be part of this section unless otherwise specifically excluded.

B. Examine all conditions as they exist at the project prior to submitting a bid for the work of this SECTION

C. Refer to SECTION 01 23 00 ALTERNATES for working affection this SECTION.

D. Related Documents:
1. Drawings and general provisions of the Subcontract apply to this Section.
2. Review these documents for coordination with additional requirements and information that apply to work under this Section.

E. Section Includes:
1. Furnish services, skilled and common labor, and apparatus and materials required for the complete installation as shown and within the intent of the drawings and/or these Specifications.

F. Requirements of this section apply to Division 23 Sections.

G. Related Sections:
1. Division 01 Section "General Requirements."
2. Division 01 Section "Special Procedures."
3. Division 01 Section "General Commissioning Requirements".
4. Division 01 Section "Process Systems Commissioning"
5. Division 01 Section "HVAC Systems Commissioning".
6. Division 01 Section "Electrical Systems Commissioning
7. Division 01 Section "Lateral Force Provisions".
8. Division 09 Sections on paints and coatings.

1.4 REFERENCES

A. General:
1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
3. Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.

B. Comply with Division 01 Section "General Requirements - Codes."

C. Comply with Division 01 Section "Lateral Force Procedures".

1.5 SCOPE OF WORK

A. These Division 23 specifications define the statutory, administrative, procedural, and technical requirements of the mechanical and controls modifications, replacements, and/or upgrades products and services to be provided on this Subcontract.

B. The scope of work consists of the installation of all materials to be furnished under Section 23.00.00, and without limiting the generality thereof, consists of furnishing all labor, materials, equipment, plant, transportation, rigging, staging up to 8 feet, appurtenances, and services

necessary and/or incidental to properly complete all work as shown on the Heating, Ventilating and Air Conditioning drawings, as described in the Specifications, or as reasonably inferred from either, in the opinion of the Architect

C. Provide HVAC work as indicated on the Drawings and specified in Division 23 including:
1. Prepare coordination drawings, shop drawings, submittals, as-built drawings, and operating and maintenance instructions.
2. Determine items and quantities required.
3. Provide complete, continuous, operational, and functioning systems.
4. Fully coordinate with work of other Sections, including field verification of elevations, dimensions, clearance, and access.
5. Repair of all damage done to premises as a result of this installation and removal of debris left by those engaged in this installation.
6. Rigging, hoisting, transportation, and associated work necessary for placement of equipment in the final location shown.
7. Disassembly and re-assembly of equipment furnished under this Section, should this be required in order to move equipment into final location shown on the Drawings.
8. Labor, materials, tools, appliances and equipment that are required to furnish and install the complete installation for this section of the work including that which is reasonably inferred.
9. Cooperation with other crafts in putting the installation in place at a time when space required is accessible.
10. Temporary scaffolding necessary for performance of the work in this Division.
11. Cutting and core drilling required for work of Division 23, including locating of rebar or coordination of locating rebar with the General Contractor.
12. Pipe sleeves for all holes in walls, floors, and ceilings, and cutting of floor slabs and slabs on grade.
13. Waterproofing where necessary for installation under this Division.
14. Cooperation with and assistance to the Facilities Monitoring and Control System Contractor as required to provide a complete and functional HVAC system.
15. Counterflashing of roof penetrations for work of Division 23.
16. Sizes, and locations for installation of any curbs and pads for work of Division 23.
17. Temporary and permanent stands and supports for equipment requiring them including vibration isolation.
18. Temporary protection of existing installation.
19. Stenciling and equipment identification.
20. Firestopping of penetrations of ducts, piping, and conduits through walls, floors, and ceiling assemblies.
21. Temporary utilities as required to install work on Division 23 including lighting, water, gas, electricity, etc.
22. Fees, permits, inspections, taxes, and approach from agencies that have jurisdiction over installation of Division 23.
23. Air and water balancing.
24. Participation in and coordination with the Commissioning process.
25. Warranty.

1.6 RELATED WORK SPECIFIED ELSEWHERE

A. Related Sections:
1. Division 01 Section "General Requirements."
2. Division 01 Section "Special Procedures."
3. Division 01 Section "General Commissioning Requirements".
4. Division 01 Section "Process Systems Commissioning"
5. Division 01 Section "HVAC Systems Commissioning".
6. Division 01 Section "Electrical Systems Commissioning
7. Division 01 Section "Lateral Force Provisions".
8. Division 09 Sections on paints and coatings.

1.7 ALTERNATES

A. Attention is directed to Section 01.23.00 ALTERNATES for a detailed description of all Alternates.

B. B. The Heating, Ventilating, and Air Conditioning subcontractor shall be responsible for examining the scope of each Alternate and for the Work caused by the Alternates and for including the costs thereof in the appropriate space in paragraph A of the Form for Sub-bid.

1.8 SUBMITTALS

A. Attention is directed to Specification Section 013300 Submittals.

B. Attention is directed to Specification Section 012513 OR Equals

C. Product Data: Submit manufacturer's technical product specification sheets for each system component and device to be provided that includes data needed to prove compliance with this specification. Clearly indicate the exact model of each component to be provided.

D. Shop Drawings: The Subcontractor shall submit for approval shop drawings prepared in accordance with Division 01 Section "General Requirements", Paragraph "Shop Drawings", and as required by other sections of these specifications.
1. Shop drawings shall be drawn to a scale of 1/4 inch = 1 foot (1:25) or larger, and shall include complete dimensions, locations, elevations, and clearances for HVAC, piping, ductwork, equipment, and valve numbers.
a. Prepare in AutoCad 2007 format or as otherwise directed.
b. Identify equipment using designations shown on the Contract Documents or as directed by the University. Do not proceed with identifications without approval from the University .
2. All shop drawings shall clearly call out in bold letters and cloud symbols deviations from the specifications and contract documents, no matter how minor.

E. Coordination Drawings**:**
1. Obtain drawings from the structural, electrical, sprinkler, plumbing, sheet metal, concrete, steel, and dry wall trades.
2. Hold regular coordination sessions with trades until coordination issues are resolved.

3. Prepare separate composite coordination drawings to a scale of 1/4 inch = 1 foot (1:25) or larger, showing work of Divisions to demonstrate coordination, clearance, access, etc. between ductwork, equipment, temperature controls, cable trays, conduits, light fixtures, piping, plumbing, structural elements, architectural elements, etc. These drawings are to be the basis for the detailed shop drawings and need not be submitted, but are to be available for review upon request.
    a. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
    b. Each trade is to adjust their shop drawings based on the outcome of coordination sessions.
4. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work.
5. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
6. Indicate the proposed locations, of piping, ductwork, equipment, and materials. Include the following:
    a. Clearances for installing and maintaining insulation.
    b. Clearances for servicing and maintaining equipment, including specific ceiling tile or ceiling access panel access and space for equipment disassembly required for periodic maintenance.
    c. Equipment connections and support details.
    d. Fire-rated wall and floor penetrations.
    e. Sizes and location of required concrete pads and bases.
    f. Valve stem movement with valve stem located horizontally.
    g. Sizes and locations of new and existing equipment support curbs on roof.
    h. Sizes and locations of new openings, either sleeved, cut, or core-drilled, in new concrete construction unless specifically shown on the Structural Drawings.
7. Maintain one complete set of composite coordination drawings at the job site. Periodically update drawings based on actual field conditions.
8. Submit final coordination drawings as part of record document requirements.

F. Submit manufacturer's operation and maintenance manuals in compliance with Division 01 Section "General Requirements", Paragraph "Operation and Maintenance Data". Include a list of spare parts that the manufacturer recommends to purchase.

Submit the O&M manual at the same time that the equipment is being installed. The O&M manual shall identify the specific equipment installed with model number and manufacturer serial number and equipment data sheet. The completed data sheet shall be submitted at the same time as the O&M manual. The data sheet is provided as Section 230500A, Equipment Data Sheet. The approved O&M manual shall be provided in one hard copy and in an electronic format.

G. Lateral Force Anchorage: Submit lateral force anchorage calculations and details of anchorage of components to building including backing design. Seismic forces shall be in accordance with Division 01 Section "Lateral Force Provisions" with value 1.5 used as the minimum CBC seismic importance factor, Ip. Calculations shall be sealed by a Structural Engineer registered in California.

H. Record Documents: Upon completion of the work covered by this Contract, as directed, furnish the University with as-built drawings as specified in Division 1. Include changes installed under this Contract which are not in accordance with the Contract Drawings. Note that these as-built drawings are to be based on the Contract Drawings. In addition, submit final copies of the Shop Drawings and Coordination Drawings.

1.9 RECORD DRAWINGS

A. Refer to Specification Section 01.78.39 for the Record Drawing requirements for this section.

B. The marked up As Built Drawings required to be maintained under this section are of Drawings M1.00 -M2.01.

C. Availability of marked up As Built drawings shall be a prerequisite to scheduling final inspection of this contract and said drawings and original contract documents will be used in checking completion of the work..

D. Non-availability of marked up As Built drawings or inaccuracies therein may be grounds for cancellation and postponement of any scheduled final inspection by the Architect until the discrepancy has been corrected.

1.10 QUALITY ASSURANCE

A. Materials and Equipment: Materials and equipment shall be new. Materials and equipment for which tests have been established by Underwriter's Laboratories, Inc. shall be approved by that body and shall bear its label of approval.
   1. The first names manufacturer and product is the basis of design. Other manufacturers and products are considered as substitutions.

B. In lieu of listing by an approved testing laboratory, consideration will be given to certified test reports of an adequately equipped, recognized independent test laboratory competent to perform such testing indicating conformance to requirements of the applicable Underwriter's Laboratories, Inc. standards.

C. Unless otherwise approved by the Project Manager, the materials to be furnished under this specification shall be the standard products of manufacturers regularly engaged in the production of such equipment equal to or superior to the material specified, and shall be the manufacturer's latest standard design that complies with the specification requirements.

D. Approval of Materials:
   1. Division 01 Section "General Requirements" requirements for "Materials and Equipment" and "Submittals".
   2. A complete list of materials and equipment proposed shall be submitted to the Project Manager for approval. The list shall include for each item: the manufacturer, the manufacturer's catalog number, type or class, the rating, capacity, size, etc.

3. Before installation of the equipment, the Subcontractor shall submit for approval detailed construction drawings for each item of fabricated equipment required for installation. Drawings shall be to scale and fully dimensioned and shall provide sufficient detail to clearly indicate the arrangement of equipment and its components.
4. Installation of approved substituted equipment is the Subcontractor's responsibility, and changes required to work included under other divisions for installations of approved substituted equipment must be made to the satisfaction of the University and without change in contract price. Approval by the University of substituted equipment and/or dimension drawings does not waive these requirements.

1.11 OPERATING AND MAINTENANCE MANUALS

A. Refer to Section 01.77.00 Close Out Procedures for the Operating and Maintenance Manual requirements for this Contract..

B. The Heating, Ventilating and Air Conditioning subcontractor shall provide the Contractor two (2) sets of operating and maintenance instructions of all mechanical and electrical equipment furnished and installed under this section.

C. The Contractor shall collect the operating instructions, bind them into two complete sets and deliver them to the Architect who will check for completeness and deliver them to the Owner.

D. Delivery of the operating and maintenance manuals shall be a condition precedent to final payment

1.12 INSTRUCTION OF OWNER'S PERSONNEL

A. Refer to Section 01.77.00 for the Instruction of Owner's Personnel requirements for this Contract.

B. The Heating, Ventilating and Air Conditioning subcontractor shall instruct the Owner's personnel, at the site, in the use and maintenance of equipment installed under this section.

C. Submission to the Architect of a certificate of compliance to this requirement, signed by the Contractor and the Owner's Representative shall be a condition precedent to final payment.

1.13 RULES AND REGULATIONS

A. See Division 01.

B. Provide work and materials in full accordance with the latest rules of the organizations listed in Division 1 and in other Sections of Division 23, and with prevailing rules and regulations pertaining to adequate protection and/or guarding of moving parts, or otherwise hazardous locations.

C. Whenever the Drawings and Specifications require something which will violate the regulations, the regulations shall govern. Review the Drawings and Specifications, and request from the University clarification or revision of portion of the work in violation of the rules or regulations prior to installing the work. Necessary installation alteration required for compliance shall be made at no additional cost to the University.

D. Whenever the Drawings and Specifications require larger sizes, or higher standards than are required by the regulations, the Drawings and Specifications shall govern.

E. Strictly conform to the requirements of the National Fire Protection Association, National Electrical Code, California Title 24 Codes, OSHA, Fire Marshal, and insurance underwriters' requirements. expenses required shall be borne under this Contract.

1.14 PROTECTION OF EQUIPMENT

A. Protect, handle, and store products under provisions of Division 01.

B. Assume responsibility for damage to of the work or premises before substantial completion. Should new or existing equipment become damaged, restore it to its original condition and finish before final acceptance. Damage incurred to the University property or to the work of other Divisions, caused by this Division, shall be replaced or repaired by, and at the expense of, the Subcontractor to the satisfaction of the University. Exposed materials shall be clean at the time of acceptance of the project.

1.15 SCHEDULING AND SEQUENCING

A. Cooperate with other trades in putting this installation in place at a time when space required is accessible, and in such a manner that other work in this space may be installed as shown on the Drawings. Schedule work and cooperate with the others to avoid delays, interferences, and unnecessary work, conforming to the construction schedule, making the installation when and where directed.
   1. Include labor and materials to install certain items furnished under this contract when required by the schedule. These items are part of this contract but may need to be installed only after completion of work under another contract which this contractor may or may not be participating in. It is the responsibility of this contract to coordinate with others to insure that preparations are made and ready to accept the installation of these items. These items include, but are not limited to:
      a. Air inlets and outlet
      b. Temperature sensors.
      c. Monitoring and control panels.
      d. Sprinkler heads.

B. If a discrepancy is discovered between engineering and architectural Drawings, whether with respect to a significant variance between location, variation in quantity, or violation of code

requirements, notify Architect for clarification and do not proceed with the work affected until clarification has been made.

C. Schedule work in advance with the University. No system shall be shutdown unless approved in writing.

1.16 TEMPORARY USE

A. Should it become necessary to use the new portion of the system and the new equipment to warm or air condition part of the building before the completion of this work, the University reserves the right to make use of same at its own risk and expense, but the temporary use of the equipment shall not constitute an acceptance of the plant or part thereof in way. The University will bear the cost of fuel and electrical current for such temporary use of the equipment. If temporary use of new systems or equipment is solely for the benefit of the contractor, contractor shall bear the cost of fuel and electrical current for such temporary use.

1.17 WARRANTY

A. Notwithstanding any other requirements of this contract, the Heating, Ventilating and Air Conditioning Subcontractor shall guarantee the performance of the installation and equipment included in this Section for one year from the date of Substantial Completion as defined in Article 9.6 of the General Conditions. Should any defects in materials or workmanship appear during this period, they shall be corrected or replaced by the Heating, Ventilating and Air Conditioning Subcontractor to the satisfaction of the Architect, and at no expense to the Owner.

B. Comply with Division 01 Section "General Requirements."

C. Provide extended warranties where specifically required in subsequent sections of Division 23.

1.18 PERMIT

A. The subcontractor’s attention is directed to subparagraph 4.16 of the General Conditions and Specification Section 01.41.23 Fees and Permits. Comply with Division 01 Section "General Requirements."

PART 2 - PRODUCTS

2.1 GENERAL

A. In addition to material and equipment specified, provide incidental materials to effect a complete installation. Such incidental materials include solders, tapes, caulkings, mastics, gaskets and similar items.

B. Materials and equipment shall be uniform throughout the installation. Equipment of the same type shall be of the same manufacturer. materials and equipment shall be new.

2.2 MATERIALS AND SUBSTITUTIONS

A. Comply with Division 01 Section "General Requirements - Specified Items and Substitutes."

PART 3 - EXECUTION

3.1 EXAMINATION OF SITE

A. Examine the site and become familiar with conditions that may affect the work covered by this division of the Specifications.

B. Arrange to meet with the University at the job site before the work is started and discuss with them the various phases of the work and the procedure and preparation for testing and adjusting the systems.

C. The general arrangement and location of piping ductwork, apparatus, etc., is shown on the Drawings or herein specified. Minor changes may be necessary to accommodate other work, new or existing, that may conflict with this work. Install this work in harmony with these trades and fully coordinate work.

D. Visit the site of the work, take measurements, examine areas where work is to be performed and get such other information necessary for proper execution of the work. Ascertain and check conditions with the Drawings and Specifications, other trades, existing conditions and by what means the work is to be performed. No allowance shall subsequently be made for extra expense due to failure or neglect to make such examination and correlation. Where revisions or changes in the existing work are required to permit the installation of new work, they shall be made at no additional cost to the University. No allowance shall be subsequently made for error or omission.

3.2 ACCURACY OF DATA

A. The Drawings indicate the general arrangement and location of piping, ducts, and equipment. Should it be necessary to deviate from arrangement or location indicated in order to meet architectural conditions or site conditions, or due to interference with other work, make such deviations as offsets, rises and drops in piping and ducts that may be necessary, whether shown or not, without extra expense to the University. Extreme accuracy of the data given herein and on the Drawings is not guaranteed. The Drawings and Specifications are for the assistance and guidance of this Section and exact locations, distances, and elevations shall be governed by actual site conditions.

3.3 COORDINATION ITEMS

A. Coordinate mechanical work with that of other trades in order to:
   1. Avoid interferences between general construction, mechanical, electrical, structural and other specialty trades.
   2. Maintain clearances and advise other trades of clearance requirements for operation, repair, removal and testing of mechanical equipment.
   3. Indicate aisle-ways and access-ways required on coordinated shop drawings for roof equipment area, mechanical equipment rooms, data and telecomm rooms, corridors, ceiling spaces, shafts, corridors, ceiling space, laboratories, etc.

B. Understanding of Work:
   1. Study, examine, and compare of the contract documents, including drawings and specifications. The Subcontractor shall have a full understanding of how the work in this part is scheduled, phased, and installed with work of other trades.
   2. Include in this installation piping, ductwork, devices, and equipment that are necessary for complete and operating systems as specified and as required.
   3. Connect piping and ductwork from fixtures, outlets, and devices full size to the nearest suitable main or riser.
   4. Certain installations may be presented as typical, and full details are not repeated for each case. Subcontractor shall provide complete installation as if full details apply to each and every case, and make adjustments to typical details to suit each specific installation as part of the basic work.
   5. Installation of work presented on the diagrams are applicable to the plans, and work depicted on the plans are applicable to the diagrams.
   6. If there is a discrepancy in the drawings or specifications, the contractor shall figure the work based on the most stringent requirements to complete the installation and obtain clarification from the Architect before installation.

C. Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:
   1. Coordinate mechanical systems, equipment, and materials installation with other building components.
   2. Verify dimensions by field measurements.
   3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
   4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
   5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
   6. Where mounting heights are not detailed or dimensioned, install systems, materials and equipment to provide the maximum headroom possible. Work shall be above ceilings or ceiling line.
   7. Coordinate installation and connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Coordinate with individual system requirements.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
10. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as is practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
11. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
12. Coordinate with the locations of electrical panels and avoid installing piping and ductwork over them. Electrical panels are purposely located and have priority for location. The contractor is responsible for required piping and ductwork offsets to insure that the panels are located as designed and for other conditions.
13. Perform system modification recommended by Test and Balance Agency after recommendations are accepted by the University

3.4 WORKMANSHIP AND SUPERVISION

A. Comply with of the following:

B. General Requirements, Division 01 Section "General Requirements - Coordination of Work."

C. Special Requirements Division 01 Section "Special Procedures - Quality Control", in addition to the following.
   1. Measurements: Materials installed shall be to exact field measurements.
   2. The installation depicted on the Drawings is designed to fit tightly into work under other Sections or Divisions. It is the essence of this Contract that work be completely coordinated with other Sections or Divisions, and that locations of pipes and ducts be exactly determined in the field and cleared with other Sections or Divisions before the installation of these items is begun. No extra compensation will be made for failure to observe this clause.
   3. Adequate clearance for access to operable devices and automatic devices and for access to lubrication points shall be maintained in portions of the work including ductwork and piping installed on the roof. Tripping hazards shall be avoided. All valve handles shall be installed in a horizontal position.
   4. Provide architectural access doors where shown and where required for access to equipment and operable devices.
   5. Gauges, thermometers, and other indicating devices shall be installed so that they can be easily read from the floor.
   6. All operable devices such as valves, circuit setters, strainers, and all HVAC related devices, etc shall be easily accessible from a normal placement of a portable step ladder to operate, to maintain and to obtain measurement data.

3.5 MATERIAL DELIVERY AND STORAGE

A. Comply with Division 01 Section "Special Procedures - Delivery."

B. Comply with Division 01 Section "Special Procedures - Storage."

3.6 INSTALLATION

A. Manufacturer's Directions: Follow manufacturer's directions covering points not shown on the drawings or specified herein. Manufacturer's directions do not take precedence over drawings and Specifications. Where these are in conflict with the drawings and Specifications, notify the Project Manager for clarification before installing the work.

B. Carpentry, Cutting, Patching, and Core Drilling:
   1. Provide carpentry, cutting, patching, and core drilling required for installation of material and equipment specified in this division.
   2. No penetrations shall be sleeved, cut, or core drilled through concrete construction without a submittal indicating exact locations and sizes and specific written approval from the University or unless specifically shown on the Structural Drawings.
   3. It is the Subcontractor's responsibility to accurately size and locate openings through the structure. The dimensions shown on the Structural Drawings are for general information only. Provide specific sizes, dimensions, requirements, etc.

C. Seismic Mounting:
   1. Material and equipment, including floor mounted equipment, piping, and appurtenances shall comply with Division 01 Section "Lateral Force Provisions".

D. Waterproof Construction:
   1. Maintain waterproof integrity of penetrations of materials intended to be waterproof. Provide flashings at exterior roof penetrations. Caulk penetrations of foundation walls and floors watertight. Provide membrane clamps at penetrations of waterproof membranes.
   2. Provide waterproof NEMA 3R enclosures for equipment or devices mounted outside or otherwise exposed to the weather.

E. Sleeves, Stubs, and Slab Penetrations: Division 23 Section "Hangers and Supports for HVAC Piping and Equipment".

F. Painting of Mechanical Equipment and Hardware:
   1. Comply with applicable Division 09 sections for paints and coatings.
   2. Provide moisture resistant paint for exterior painting.
   3. Colors shall be as shown on the drawings unless specified.
   4. Comply with individual Sections for other equipment to be painted.
   5. Repair damaged galvanizing, paint, or coatings. Use Z.R.C. (no known equal) cold galvanized compound for galvanized repairs.

G. Concrete Equipment Bases:

1. All equipment located on concrete floor inside the building or on grade outside the building, shall be mounted on a concrete base. The concrete base shall be four inches high and shall extend six inches beyond the edge of equipment base unless indicated otherwise on drawings.
2. Coordinate concrete bases: Concrete bases indicated on Architectural or Structural drawings are specified in other Divisions. Concrete bases not on Architectural or Structural drawings are requirements of this Division.

3.7 PIPING AND EQUIPMENT IDENTIFICATION

A. Comply with Division 23 Section "Identification for HVAC Piping and Equipment.

3.8 NOISE AND VIBRATION

A. The target room NC sound levels for the operating HVAC system is as follows:

Rooms with Fume Hoods	55 (not including fume hood components)
Labs with Benches	45
Lab Support Rooms	45
Clean Rooms	55
Conference Rooms	36
Corridors/Utility Areas	45

B. Vibration levels shall not exceed vibration criteria listed in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment".

C. If noise or vibration problems are a result of improper material or installation, or exceeds limits by Paragraphs - 3.03.A and3.03.B, these conditions shall be corrected by the Subcontractor at no cost to the University.

3.9 SHUTDOWN AND SCHEDULING

A. Comply with Division 01 "Special Procedures - Shutdown."

3.10 PROTECTION OF EQUIPMENT

A. Care shall be exercised during construction to avoid damage or disfigurement. Equipment shall be protected from dust and moisture prior to and during construction. The Subcontractor is cautioned that concrete finishing, painting, etc. in electrical rooms shall not proceed if unprotected equipment is installed.

B. Where required or directed, construct temporary protection for equipment and installations for protection from dust and debris caused by construction.

C. All protection shall be substantially constructed with the use of clean canvas, heavy plastic, visqueen and plywood as required, and made tight and dust proof as directed.

D. The Subcontractor shall repair by spray or brush painting, after properly preparing the surface, scratches or defects in the finish of the equipment. Only identical paint furnished by the equipment manufacturer shall be used for such purposes.

E. Failure of the Subcontractor to protect the equipment as outlined herein shall be grounds for rejection of the equipment and its installation.

3.11 INSPECTIONS

A. Comply with Special Requirements, Division 01 Section "Special Procedures - Inspections."

3.12 REMOVED EQUIPMENT AND MATERIALS

A. Comply with Division 01 Section "Special Procedures - U. S. Government and/or University Property - Materials To Be Removed."

3.13 CLEANING

A. Comply with Division 01 Section "Special Procedures - Cleaning."

3.14 LUBRICATION

A. All lubrication points shall be accessible. Where this is impossible, provision shall be made for lubrication at an accessible location. Where oil is used, an oil level indicator and capped, vented filling connection shall be provided and firmly mounted in an accessible space and shall be connected to the bearing with pipe(s) as required. Where grease is used for lubricant, the pipe shall have a suitable lubricating fitting installed at the accessible end. Equipment shall be thoroughly lubricated before operation and at time work is accepted.

3.15 SEALANTS

A. See Division 07 Sections for sealing duct, pipe, and conduit penetrations through walls, partitions, and floors.

1. Completely seal duct, pipe and conduit penetrations through rated and non-rated walls.

3.16 TESTS

A. Upon completion of the mechanical construction work, perform tests and provide test reports as specified in this and other sections.
   1. All tests shall be made in the presence of a representative of the Project Manager. The application or interruption of mechanical utilities shall be programmed and directed by the Project Manager.
   2. The Subcontractor shall submit to the Project Manager 3 copies of test results, certified in writing, witnessed, signed and dated, immediately upon completion of work. Unsatisfactory condition revealed by these test results, or unsatisfactory methods of tests and/or testing apparatus and instruments, shall be corrected by the Subcontractor to the satisfaction of the Project Manager.
   3. The Project Manager reserves the right to require that the Subcontractor perform and repeat tests that are deemed necessary to complete or check the tests or the certified records of the Subcontractor during the course of the work. Correct unsatisfactory portion of its work that is revealed by the tests or that may be due to progressive deterioration during this period, unless the item in question was a direct specification.

3.17 COMMISSIONING

A. Perform commissioning requirements of:
   1. Division 01 Section "General Commissioning Requirements".
   2. Division ** Section "Commissioning of Process Sys[1]
   3. Division 23 Section "Commissioning of HVAC"
   4. Division 26 Section "Commissioning of Electrical Systems".

B. Commissioning is included as a part of the total package of quality assurance and quality control for this project. Commissioning is to be integrated into the project as the process that oversees and verifies the functional performance of equipment, systems, and assemblies via observation and testing. Include coordination with and full participation in the commissioning process. Commissioning shall include but not be limited to field observations, factory and site tests, pre-start checks, start-up checks, functional test procedure review, functional testing, commissioning meetings, documentation, test interpretation, and deficiency correction. The details of these requirements are described in the above Sections and other referenced Sections and are herby incorporated by reference into the work of this Division.

3.18 MAINTENANCE AND OPERATING INSTRUCTIONS AND TRAINING

A. Refer to Division 01 Section "General Requirements", for maintenance and operating instructions, and training requirements.

B. At time of occupancy, arrange for manufacturer's representatives to instruct operating and maintenance personnel in the use of equipment requiring operating and maintenance. Arrange for personnel to be instructed at one time. Costs for this service shall be included in the Subcontract.

C. Maintenance and operating instructions and training for University-furnished equipment will be provided by the equipment vendor. The Subcontractor shall be responsible for other equipment.

END OF SECTION

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 – GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
1. Provide Payment and Performance Bonds for the full value of their Subcontract.
2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
1. Comply with the Instructions to Bidders.
2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
FILED SUBCONTRACTOR'S BID FOR SECTION:
23 05 13 – COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
1. All subcontractors to the Filed Subcontractor, whose work is:
   a. Valued at $10,000 or more.
2. The contract sum for each subcontractor required to be listed.
   a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
4. Comply with the applicable General Laws and the following:
   a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None.	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. M1.00 – Mechanical Notes
2. M1.01 – Mechanical Details
3. M1.02 – Mechanical Specifications
4. M1.03 – Mechanical Zoning Plan
5. M2.00 – Mechanical Floor Plan
6. M2.01 – Mechanical Ventilation/Heating Plan
7. M2.02 – Mechanical Roof Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 23 00 00 – Common Work Results for HVAC
2. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
3. Section 23 05 48 – Vibration and Controls for HVAC Piping and Equipment
4. Section 23 05 53 – Identification for HVAC Piping and Equipment
5. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
6. Section 23 07 13 – Duct Insulation
7. Section 23 08 00 – Commissioning of HVAC
8. Section 23 09 00 – Instrumentation and Controls for HVAC
9. Section 23 31 13 – Metal Ducts
10. Section 23 33 00 – Air Duct Accessories
11. Section 23 34 23 – HVAC Power Ventilators
12. Section 23 37 13 – Diffusers, Registers, and Grilles
13. Section 23 37 23 – HVAC Gravity Ventilators
14. Section 23 34 00 – Particulate Air Filtration
15. Section 23 72 00 – Air-to-Air Energy Recovery Ventilator
16. Section 23 74 16 – Package Rooftop Air Conditioning Units
17. Section 23 82 39 – Unit Heaters

B. Alternates: None.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.4 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and

installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.5 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Separate winding for each speed.

E. Rotor: Random-wound, squirrel cage.

F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating.

H. Insulation: Class F.

I. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

J. Enclosure Material: Cast iron or extruded aluminum for motors greater than 1 hp; cast iron, extruded aluminum or rolled steel for motors 1 hp and smaller.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust

loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 230548 - VIBRATION AND CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 – GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
1. Provide Payment and Performance Bonds for the full value of their Subcontract.
2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
1. Comply with the Instructions to Bidders.
2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
FILED SUBCONTRACTOR'S BID FOR SECTION:
23 05 48 – VIBRATION AND CONTROLS FOR HVAC PIPING AND EQUIPMENT

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
1. All subcontractors to the Filed Subcontractor, whose work is:
   a. Valued at $10,000 or more.
2. The contract sum for each subcontractor required to be listed.
   a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
4. Comply with the applicable General Laws and the following:
   a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

	Class of Work	Specification section number and name
a.	None.	None.

A. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. M1.00 – Mechanical Notes
2. M1.01 – Mechanical Details
3. M1.02 – Mechanical Specifications
4. M1.03 – Mechanical Zoning Plan
5. M2.00 – Mechanical Floor Plan
6. M2.01 – Mechanical Ventilation/Heating Plan
7. M2.02 – Mechanical Roof Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 23 00 00 – Common Work Results for HVAC
2. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
3. Section 23 05 48 – Vibration and Controls for HVAC Piping and Equipment
4. Section 23 05 53 – Identification for HVAC Piping and Equipment
5. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
6. Section 23 07 13 – Duct Insulation
7. Section 23 08 00 – Commissioning of HVAC
8. Section 23 09 00 – Instrumentation and Controls for HVAC
9. Section 23 31 13 – Metal Ducts
10. Section 23 33 00 – Air Duct Accessories
11. Section 23 34 23 – HVAC Power Ventilators
12. Section 23 37 13 – Diffusers, Registers, and Grilles
13. Section 23 37 23 – HVAC Gravity Ventilators
14. Section 23 34 00 – Particulate Air Filtration
15. Section 23 72 00 – Air-to-Air Energy Recovery Ventilator
16. Section 23 74 16 – Package Rooftop Air Conditioning Units
17. Section 23 82 39 – Unit Heaters

B. Alternates: None.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.4 SUMMARY

A. This Section includes the following:

1. Isolation pads.
2. Isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Freestanding and restrained spring isolators.
5. Housed spring mounts.
6. Elastomeric hangers.
7. Spring hangers.
8. Spring hangers with vertical-limit stops.
9. Pipe riser resilient supports.
10. Resilient pipe guides.
11. Freestanding and restrained air-mounting system.
12. Restrained vibration isolation roof-curb rails.
13. Restraining braces and cables.
14. Steel and inertia, vibration isolation equipment bases.

1.5 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.6 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Loading:

1. Basic Wind Speed: 120 mph.
2. Building Classification Category: III.
3. Minimum 10 lb/sq. ft. (48.8 kg/sq. m) multiplied by the maximum area of the HVAC component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

1.7 ACTION SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation restraint details 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. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, wind forces required to select vibration isolators, wind restraints, and for designing

vibration isolation bases.

a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure and spring deflection changes. Include certification that riser system has been examined for excessive stress and that none will exist.

3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
4. Wind Restraint Details:

a. Design Analysis: To support selection and arrangement of wind restraints. Include calculations of combined tensile and shear loads.
b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Indicate association with vibration isolation devices.
c. Coordinate vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.8 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Air-Mounting System Performance Certification: Include natural frequency, load, and damping test data.

D. Field quality-control test reports.

1.9 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.10 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Kinetics Noise Control.
2. Mason Industries.
3. Vibro-Acoustics.

B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene, rubber, hermetically sealed compressed fiberglass.

C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory- drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

D. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- (6-mm-) thick, rubber

isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig (3447 kPa).

6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

E. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

F. Housed Spring Mounts: Housed spring isolator with integral snubbers.

1. Housing: Ductile-iron or steel housing to provide all-directional restraint.
2. Base: Factory drilled for bolting to structure.
3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch (6-mm) travel up or down before contacting a resilient collar.

G. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

H. Spring Hangers: Combination coil-spring and elastomeric- insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

I. Spring Hangers with Vertical-Limit Stop: Combination coil- spring and elastomeric-insert hanger with spring and insert in compression and with a vertical- limit stop.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

J. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig (3.45 MPa) and for equal resistance in all directions.

K. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 AIR-MOUNTING SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. California Dynamics Corporation.
2. Firestone Industrial Products Company.
3. Kinetics Noise Control.
4. Mason Industries.
5. Vibration Eliminator Co., Inc.

B. Air Mounts: Freestanding, single or multiple, compressed-air bellows.

1. Assembly: Upper and lower steel sections connected by a replaceable, flexible, nylon-reinforced neoprene bellows.
2. Maximum Natural Frequency: 3 Hz.
3. Operating Pressure Range: 25 to 100 psig (172 to 690 kPa).
4. Burst Pressure: At least three times manufacturer's published maximum operating pressure.

5. Leveling Valves: Minimum of 3 required to maintain leveling within plus or minus 1/8 inch (3 mm).

C. Restrained Air Mounts: Housed compressed-air bellows.

1. Assembly: Upper and lower steel sections connected by a replaceable, flexible, nylon- reinforced neoprene bellows and spring, with angle-iron frame having vertical-limit stops and channel-section top with leveling adjustment and attachment screws.
2. Maximum Natural Frequency: 3 Hz.
3. Operating Pressure Range: 25 to 100 psig (172 to 690 kPa).
4. Burst Pressure: At least three times manufacturer's published maximum operating pressure.
5. Leveling Valves: Minimum of 3 required to maintain leveling within plus or minus 1/8 inch (3 mm).

2.3 RESTRAINED VIBRATION ISOLATION ROOF-CURB RAILS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Isolation Technology, Inc.
4. Kinetics Noise Control.
5. Mason Industries.
6. Thybar Corporation.
7. Vibration Eliminator Co., Inc.
8. Vibration Isolation.
9. Vibration Mountings & Controls, Inc.

B. General Requirements for Restrained Vibration Isolation Roof-Curb Rails: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand wind forces.

C. Lower Support Assembly: Formed sheet-metal section containing adjustable and removable steel springs that support upper frame. Upper frame shall provide continuous support for equipment and shall be captive to resiliently resist wind forces. Lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials and shall be insulated with a minimum of 2 inches (50 mm) of rigid, glass-fiber insulation on inside of assembly.

D. Spring Isolators: Adjustable, restrained spring isolators shall be mounted on 1/4-inch- (6-mm-) thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.

1. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with wind restraint.

a. Housing: Steel with resilient vertical-limit stops and adjustable equipment mounting and leveling bolt.
b. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
c. Minimum Additional Travel: 50 percent of the required deflection at rated load.
d. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
e. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

a. Resilient Material: Oil- and water-resistant standard neoprene, natural rubber, hermetically sealed compressed fiberglass.

E. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch (6 mm) thick.

F. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.

2.4 VIBRATION ISOLATION EQUIPMENT BASES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Isolation Technology, Inc.
4. Kinetics Noise Control.
5. Mason Industries.
6. Vibration Eliminator Co., Inc.
7. Vibration Isolation.
8. Vibration Mountings & Controls, Inc.

B. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25- mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.

3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25- mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.5 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and and wind-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

3.3 VIBRATION-CONTROL RESTRAINT DEVICE INSTALLATION

A. Comply with requirements in Section 077200 "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

B. Equipment Restraints:

1. Install snubbers on HVAC equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
3. Install restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

C. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
3. Brace a change of direction longer than 12 feet (3.7 m).

D. Install cables so they do not bend across edges of adjacent equipment or building structure.

E. Install restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

F. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

G. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

H. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

I. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for

anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
3. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
4. Test to 90 percent of rated proof load of device.
5. Measure isolator restraint clearance.
6. Measure isolator deflection.
7. Verify snubber minimum clearances.
8. Air-Mounting System Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
9. Air-Mounting System Operational Test: Test the compressed-air leveling system.
10. Test and adjust air-mounting system controls and safeties.
11. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust air-spring leveling mechanism.

D. Adjust active height of spring isolators.

E. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.6 HVAC VIBRATION-CONTROL RESTRAINT DEVICE SCHEDULE

A. Supported or Suspended Equipment:

1. Equipment Location:
2. Pads:

    a. Material: Neoprene, Rubber, or Hermetically sealed compressed fiberglass.
    b. Thickness: 1/4-inch (6-mm)
    c. Number of Pads: 1.

3. Isolator Type: Freestanding, laterally stable, open-spring isolators.
5. Base Type: neoprene, rubber, or hermetically sealed compressed fiberglass.
4. Minimum Deflection: 1/4-inch (6-mm).
5. Component Importance Factor: 1.0.
6. Component Response Modification Factor: 1.5.
7. Component Amplification Factor: 1.0.

END OF SECTION

SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 – GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
1. Provide Payment and Performance Bonds for the full value of their Subcontract.
2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
1. Comply with the Instructions to Bidders.
2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
FILED SUBCONTRACTOR'S BID FOR SECTION:
23 05 53 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
1. All subcontractors to the Filed Subcontractor, whose work is:
   a. Valued at $10,000 or more.
2. The contract sum for each subcontractor required to be listed.
   a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
4. Comply with the applicable General Laws and the following:
   a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

	Class of Work	Specification section number and name
a.	None.	None.

A. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. M1.00 – Mechanical Notes
2. M1.01 – Mechanical Details
3. M1.02 – Mechanical Specifications
4. M1.03 – Mechanical Zoning Plan
5. M2.00 – Mechanical Floor Plan
6. M2.01 – Mechanical Ventilation/Heating Plan
7. M2.02 – Mechanical Roof Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 23 00 00 – Common Work Results for HVAC
2. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
3. Section 23 05 48 – Vibration and Controls for HVAC Piping and Equipment
4. Section 23 05 53 – Identification for HVAC Piping and Equipment
5. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
6. Section 23 07 13 – Duct Insulation
7. Section 23 08 00 – Commissioning of HVAC
8. Section 23 09 00 – Instrumentation and Controls for HVAC
9. Section 23 31 13 – Metal Ducts
10. Section 23 33 00 – Air Duct Accessories
11. Section 23 34 23 – HVAC Power Ventilators
12. Section 23 37 13 – Diffusers, Registers, and Grilles
13. Section 23 37 23 – HVAC Gravity Ventilators
14. Section 23 34 00 – Particulate Air Filtration
15. Section 23 72 00 – Air-to-Air Energy Recovery Ventilator
16. Section 23 74 16 – Package Rooftop Air Conditioning Units
17. Section 23 82 39 – Unit Heaters

B. Alternates: None.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.4 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Stencils.
6. Valve tags.
7. Warning tags.

1.5 ACTION 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. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

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 locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

1.7 WORK INCLUDED

A. Furnish and install nameplates, valve tags, valve charts, stencils and pipe markers on all Mechanical equipment, piping and ductwork.

B. Provide nameplates with the unit number and service designation on all mechanical equipment.

C. Indicate all valve tag numbers on Record Drawings and submit framed under glass valve tag charts including valve service and location.

D. Install color coded ceiling tacks in acoustical tile ceilings or color coded tape on ceiling grid to identify location of equipment, valves and dampers that require regular maintenance or are part of a life safety system (fire dampers, smoke dampers, sprinkler valves or main isolation valves). Concealed fire protection valves shall be marked by red label triangles (3" equilateral) and circle dots (1" diameter). Triangles shall be placed on the wall nearest the valve with the apex pointing toward the ceiling tile. Dots shall be placed on border of ceiling tile.

E. Provide underground plastic pipe markers 6 to 8 inches below finish grade, directly above buried pipes.

F. Provide manufactured pipe and ductwork identification stencils with flow arrows and service indicated. All backgrounds of the stencils shall be color coded with specific service designation

G. Prepare valve charts and frame under glass. All valves and the tag numbers shall be shown on the Record As-Built Drawings.

H. Provide valve computer data base to match chart.

I. Prepare and install exterior protected brass plaques indicating underground service entrances.

PART 2 - PRODUCTS

2.1 GENERAL

A. Acceptable manufactures contingent on compliance with the specification.
1. Seton
2. W. H. Bradey Company
3. Marning Services Incorporated

2.2 DUCTWORK IDENTIFICATION

A. All ductwork (supply, return, exhaust, etc.) serving multiple spaces or floors shall be identified with directional flow arrows and unit identification numbers (AHU-1, EX-1, etc.) on the side of each duct (or bottom if abutting other systems or obstructions).

B. All flow arrows and labels shall be similar to Seton Name Plate Company vinyl labels or stencil painted.

C. The kitchen hood exhaust system shall also have identified access doors with numbers of specific doors identified on the Record As-Built Drawings.

D. All duct access doors.

2.3 EQUIPMENT NAMEPLATES

A. Equipment nameplates shall be 3” x 6” long, 0.02” aluminum with a black enamel background with engraved natural aluminum letters similar to Seton Style 2065-20. Nameplate shall have pressure sensitive taped backing.

B. The nameplate shall contain the unit or equipment designation (“AHU” for air handling unit, “P” for circulating pump, etc.), unit number and area or system served.

C. Nameplates for exterior equipment shall be applied with waterproof adhesive.

2.4 UTILITY ENTRANCE DESIGNATIONS

A. Provide a brass wall plaque, minimum 0.020" thickness, secured to the exterior wall just above the grade line for all buried service entrances or exits. Samples are: Water Service Below; Gas Service Below; Sanitary Sewer Below; Storm Sewer Below; Irrigation Water Below; etc.

B. Ceiling Tacks or Tape.

C. Provide steel color coded 3/4 inch diameter ceiling tacks in acoustical tile ceilings or color coded tape applied to ceiling grid to locate equipment, valves or dampers that require regular maintenance or are part of a Life Safety System.

D. The tacks or tapes shall be color codes as follows:
1. Yellow – HVAC
2. Red – Life Safety (fire dampers, sprinkler valves, etc.)
3. Green - Plumbing Valves.
4. Blue – Heating/Cooling Valves.

PART 3 - EXECUTION

3.1 PREPARATION

A. All surfaces shall be cleaned and insulated (if applicable) prior to installing any identification.

B. Exterior surfaces of outdoor equipment shall be dry and prepared to accept the specified identification.

3.2 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion. Seal with clear lacquer.

B. Install duct markers in accordance with manufacturer's instructions.

C. Identify air handling units, pumps, domestic hot water heaters, fire pumps, heat transfer equipment tanks, water treatment devices, etc. with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.

D. Identify control panels and major control components outside panels with plastic nameplates.

E. Install detector tape on all underground services in accordance with the manufactures recommendations.

F. Identify thermostats relating to air handling equipment serving multiple spaces.

G. Tag automatic controls, instruments and relays. Key to control schematic.

H. Identify ductwork with plastic nameplates and flow arrows. Identify with air handling unit or fan identification number and area served. Locate identification at air handling unit or fan, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 – GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
1. Provide Payment and Performance Bonds for the full value of their Subcontract.
2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
1. Comply with the Instructions to Bidders.
2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
FILED SUBCONTRACTOR'S BID FOR SECTION:
23 05 93 – TESTING, ADJUSTING, AND BALANCING FOR HVAC

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
1. All subcontractors to the Filed Subcontractor, whose work is:
a. Valued at $10,000 or more.
2. The contract sum for each subcontractor required to be listed.
a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
4. Comply with the applicable General Laws and the following:
a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

	Class of Work	Specification section number and name
a.	None.	None.

A. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. M1.00 – Mechanical Notes
2. M1.01 – Mechanical Details
3. M1.02 – Mechanical Specifications
4. M1.03 – Mechanical Zoning Plan
5. M2.00 – Mechanical Floor Plan
6. M2.01 – Mechanical Ventilation/Heating Plan
7. M2.02 – Mechanical Roof Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 23 00 00 – Common Work Results for HVAC
2. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
3. Section 23 05 48 – Vibration and Controls for HVAC Piping and Equipment
4. Section 23 05 53 – Identification for HVAC Piping and Equipment
5. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
6. Section 23 07 13 – Duct Insulation
7. Section 23 08 00 – Commissioning of HVAC
8. Section 23 09 00 – Instrumentation and Controls for HVAC
9. Section 23 31 13 – Metal Ducts
10. Section 23 33 00 – Air Duct Accessories
11. Section 23 34 23 – HVAC Power Ventilators
12. Section 23 37 13 – Diffusers, Registers, and Grilles
13. Section 23 37 23 – HVAC Gravity Ventilators
14. Section 23 34 00 – Particulate Air Filtration
15. Section 23 72 00 – Air-to-Air Energy Recovery Ventilator
16. Section 23 74 16 – Package Rooftop Air Conditioning Units
17. Section 23 82 39 – Unit Heaters

B. Alternates: None.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.4 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

    a. Constant-volume air systems.
    b. Multizone systems.

1.5 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

1.6 ACTION SUBMITTALS

A. Submittals:

1. Air-Balance Report for Prerequisite IEQ 1: Documentation of work performed for ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

2. TAB Report for Prerequisite EA 2: Documentation of work performed for ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. Certified TAB reports.

E. Sample report forms.

F. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.8 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC or NEBB.
2. TAB Technician: Employee of the TAB contractor and who is certified by AABC or NEBB as a TAB technician.

B. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard TAB contractor's forms.

D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

F. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.7 1. Notice: Provide seven days advance notice for each test. Include scheduled test dates and times.
2. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to report any observed issues that would prevent from meeting the leakage class of connected ducts as specified in Section 233113 "Metal Ducts" and that the plenums are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

F. Examine equipment performance data including fan and pump curves.

1. Include in test report Project conditions and observed system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Test and report HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine test reports specified in individual system and equipment Sections.

H. Observe and report HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

I. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

J. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

K. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

M. Examine system pumps to ensure absence of entrained air in the suction piping.

N. Observe and report any deficiencies in operating safety interlocks and controls on HVAC equipment.

O. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare progress reports weekly. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Automatic temperature-control systems are operational.
3. Equipment and duct access doors are securely closed.
4. Balance, smoke, and fire dampers are open.
5. Isolating and balancing valves are open and control valves are operational.
6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
7. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. After testing and balancing, verify and report any problems with test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. For variable-air-volume systems, develop a plan to simulate diversity.

C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check dampers for proper position to achieve desired airflow path.

H. Check for airflow blockages.

I. Check condensate drains for proper connections and functioning.

J. Report any observed problems and verify leakage calculations done by others for proper sealing of air-handling-unit components.

K. Report any observed issues associated with the sealing of the air duct system.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

    a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.

2. Measure fan static pressures as follows to determine actual static pressure:

    a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    b. Measure static pressure directly at the fan outlet or through the flexible connection.
    c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.

d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

a. Report the cleanliness status of filters and the time static pressures are measured.

4. Measure static pressures entering and leaving other devices, such as sound traps, heat- recovery equipment, and air washers, under final balanced conditions.
5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Recommend adjustments to accommodate actual conditions.
6. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full- heating, economizer, smoke evacuation (if applicable) and any other specified operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.

a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities

without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR MULTIZONE SYSTEMS

A. Set unit at maximum airflow through the cooling coil.

B. Adjust each zone's balancing damper to achieve indicated airflow within the zone.

3.7 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.8 TOLERANCES

A. Set HVAC system's air flow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
2. Air Outlets and Inlets: Plus or minus 10 percent.
3. Heating-Water Flow Rate: Plus or minus 10 percent.
4. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.9 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems

serving multiple floors.

3.10 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Fan curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB contractor.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of testing conditions system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.

c. Cooling coil, wet- and dry-bulb conditions.
d. Face and bypass damper settings at coils.
e. Fan drive settings including settings and percentage of maximum pitch diameter.
f. Settings for supply-air, static-pressure controller.
g. Other system operating conditions that affect performance.

D. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Unit arrangement and class.
g. Discharge arrangement.
h. Sheave make, size in inches (mm), and bore.
i. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
j. Number, make, and size of belts.
k. Number, type, and size of filters.

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches (mm), and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

3. Test Data (Indicated and Actual Values):

a. Total air flow rate in cfm (L/s).
b. Total system static pressure in inches wg (Pa).
c. Fan rpm.
d. Discharge static pressure in inches wg (Pa).
e. Filter static-pressure differential in inches wg (Pa).
f. Preheat-coil static-pressure differential in inches wg (Pa).
g. Cooling-coil static-pressure differential in inches wg (Pa).
h. Heating-coil static-pressure differential in inches wg (Pa).
i. Minimum outdoor airflow in cfm (L/s).
j. Return airflow in cfm (L/s).
k. Outdoor-air damper position.
l. Return-air damper position.
m. Vortex damper position.

E. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches (mm), and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).

2. Motor Data:

a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches (mm), and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches (mm).
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm (L/s).
b. Total system static pressure in inches wg (Pa).
c. Fan rpm.
d. Discharge static pressure in inches wg (Pa).
e. Suction static pressure in inches wg (Pa).

F. Round, Flat-Oval, and Rectangular Duct Traverse Reports:

1. Report Data:

a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F (deg C).
d. Duct static pressure in inches wg (Pa).
e. Duct size in inches (mm).
f. Duct area in sq. ft. (sq. m).
g. Indicated air flow rate in cfm (L/s).
h. Indicated velocity in fpm (m/s).
i. Actual air flow rate in cfm (L/s).
j. Actual average velocity in fpm (m/s).

k. Barometric pressure in psig (Pa) or corrected to location.

G. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.11 INSPECTIONS

A. Refer to commissioning specification.

END OF SECTION

SECTION 230713 - DUCT INSULATION

PART 1 – GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
1. Provide Payment and Performance Bonds for the full value of their Subcontract.
2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
1. Comply with the Instructions to Bidders.
2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
FILED SUBCONTRACTOR'S BID FOR SECTION:
23 07 13 – DUCT INSULATION

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
1. All subcontractors to the Filed Subcontractor, whose work is:
a. Valued at $10,000 or more.
2. The contract sum for each subcontractor required to be listed.
a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
4. Comply with the applicable General Laws and the following:
a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

	Class of Work	Specification section number and name
a.	None.	None.

A. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. M1.00 – Mechanical Notes
2. M1.01 – Mechanical Details
3. M1.02 – Mechanical Specifications
4. M1.03 – Mechanical Zoning Plan
5. M2.00 – Mechanical Floor Plan
6. M2.01 – Mechanical Ventilation/Heating Plan
7. M2.02 – Mechanical Roof Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 23 00 00 – Common Work Results for HVAC
2. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
3. Section 23 05 48 – Vibration and Controls for HVAC Piping and Equipment
4. Section 23 05 53 – Identification for HVAC Piping and Equipment
5. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
6. Section 23 07 13 – Duct Insulation
7. Section 23 08 00 – Commissioning of HVAC
8. Section 23 09 00 – Instrumentation and Controls for HVAC
9. Section 23 31 13 – Metal Ducts
10. Section 23 33 00 – Air Duct Accessories
11. Section 23 34 23 – HVAC Power Ventilators
12. Section 23 37 13 – Diffusers, Registers, and Grilles
13. Section 23 37 23 – HVAC Gravity Ventilators
14. Section 23 34 00 – Particulate Air Filtration
15. Section 23 72 00 – Air-to-Air Energy Recovery Ventilator
16. Section 23 74 16 – Package Rooftop Air Conditioning Units
17. Section 23 82 39 – Unit Heaters

B. Alternates: None.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.4 SUMMARY

A. Section includes insulating the following duct services:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
7. Indoor, concealed oven and warewash exhaust.
8. Indoor, exposed oven and warewash exhaust.
9. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
10. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
11. Outdoor, concealed supply and return.
12. Outdoor, exposed supply and return.

B. Related Sections:

1. Section 23 07 16 "HVAC Equipment Insulation."
2. Section 23 31 13 "Metal Ducts" for duct liners.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.9 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.10 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I, Type II with factory- applied vinyl jacket, Type III with factory-applied FSK jacket, or Type III with factory- applied FSP jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; SoftTouch Duct Wrap.
b. Johns Manville; Microlite.
c. Knauf Insulation; Friendly Feel Duct Wrap.
d. Manson Insulation Inc.; Alley Wrap.
e. Owens Corning; SOFTR All-Service Duct Wrap.

G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ or with factory- applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; Commercial Board.
b. Fibrex Insulations Inc.; FBX.
c. Johns Manville; 800 Series Spin-Glas.
d. Knauf Insulation; Insulation Board.
e. Manson Insulation Inc.; AK Board.
f. Owens Corning; Fiberglas 700 Series.

H. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ or FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. (40 kg/cu. m) or more. Thermal conductivity (k- value) at 100 deg F (55 deg C) is 0.29 Btu x in./h x sq. ft. x deg F (0.042 W/m x K) or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; CrimpWrap.
b. Johns Manville; MicroFlex.
c. Knauf Insulation; Pipe and Tank Insulation.
d. Manson Insulation Inc.; AK Flex.
e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.2 FIRE-RATED INSULATION SYSTEMS

A. Fire-Rated Board: Structural-grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1700 deg F (927 deg C). Comply with ASTM C 656, Type II, Grade 6. Tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Johns Manville; Super Firetemp M.

B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 2-hour fire rating by an NRTL acceptable to authorities having jurisdiction.

1. Products: Subject to compliance with requirements, provide one of the following:

a. CertainTeed Corp.; FlameChek.
b. Johns Manville; Firetemp Wrap.
c. Nelson Fire Stop Products; Nelson FSB Flameshield Blanket.
d. Thermal Ceramics; FireMaster Duct Wrap.
e. 3M; Fire Barrier Wrap Products.
f. Unifrax Corporation; FyreWrap.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Aeroflex USA, Inc.; Aeroseal.
b. Armacell LLC; Armaflex 520 Adhesive.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.Eagle Bridges - Marathon Industries; 225.
    b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    b. Eagle Bridges - Marathon Industries; 225.
    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.Mon-Eco Industries, Inc.; 22-25.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Dow Corning Corporation; 739, Dow Silicone.
    b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    c. P.I.C. Plastics, Inc.; Welding Adhesive.
    d. Speedline Corporation; Polyco VP Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive 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."

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
b. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm (0.009 metric perm) at 43-mil (1.09-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
b. Eagle Bridges - Marathon Industries; 501.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
d. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.03 metric perm) at 35-mil (0.9- mm) dry film thickness.
3. Service Temperature Range: 0 to 180 deg F (Minus 18 to plus 82 deg C).
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
b. Eagle Bridges - Marathon Industries; 570.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm (0.033 metric perm) at 30-mil (0.8- mm) dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F (Minus 46 to plus 104 deg C).
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
5. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
b. Eagle Bridges - Marathon Industries; 550.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
d. Mon-Eco Industries, Inc.; 55-50.
e. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms (1.2 metric perms) at 0.0625-inch (1.6-mm) dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F (Minus 29 to plus 82 deg C).
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
b. Vimasco Corporation; 713 and 714.

3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
4. Service Temperature Range: 0 to plus 180 deg F (Minus 18 to plus 82 deg C).
5. Color: White.

2.6 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.Eagle Bridges - Marathon Industries; 405.
   b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
   c. Mon-Eco Industries, Inc.; 44-05.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. ASJ Flashing Sealants, and Vinyl and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F (Minus 40 to plus 121 deg C).
5. Color: White.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.

5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms (0.86 metric perm) when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric: Approximately 6 oz./sq. yd. (203 g/sq. m) with a thread count of 5 strands by 5 strands/sq. in. (2 strands by 2 strands/sq. mm) for covering ducts.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Chil-Glas No. 5.

B. Woven Polyester Fabric: Approximately 1 oz./sq. yd. (34 g/sq. m) with a thread count of 10 strands by 10 strands/sq. in. (4 strands by 4 strands/sq. mm), in a Leno weave, for ducts.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Mast-A-Fab.
b. Vimasco Corporation; Elastafab 894.

2.9 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd. (271 g/sq. m).

1. Products: Subject to compliance with requirements, provide the following:

a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

2.10 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Johns Manville; Zeston.
b. P.I.C. Plastics, Inc.; FG Series.
c. Proto Corporation; LoSmoke.
d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.

D. Metal Jacket:
1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
c. RPR Products, Inc.; Insul-Mate.

2. Aluminum Jacket: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005, Temper H-14.

a. Sheet and roll stock ready for shop or field sizing.
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat- bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat- bonded polyethylene and kraft paper.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

a. Sheet and roll stock ready for shop or field sizing.
b. Material, finish, and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 1-mil- (0.025-mm-) thick, heat- bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil- (0.075-mm-) thick, heat- bonded polyethylene and kraft paper.

E. Self-Adhesive Outdoor Jacket: 60-mil- (1.5-mm-) thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.

1. Products: Subject to compliance with requirements, provide the following:

a. Polyguard Products, Inc.; Alumaguard 60.

2.11 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 428 AWF ASJ.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
c. Compac Corporation; 104 and 105.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches (75 mm).
3. Thickness: 11.5 mils (0.29 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 491 AWF FSK.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
c. Compac Corporation; 110 and 111.
d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches (75 mm).
3. Thickness: 6.5 mils (0.16 mm).
4. Adhesion: 90 ounces force/inch (1.0 N/mm) in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch (7.2 N/mm) in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 370 White PVC tape.
b. Compac Corporation; 130.
c. Venture Tape; 1506 CW NS.

2. Width: 2 inches (50 mm).
3. Thickness: 6 mils (0.15 mm).
4. Adhesion: 64 ounces force/inch (0.7 N/mm) in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch (3.3 N/mm) in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 488 AWF.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
c. Compac Corporation; 120.
d. Venture Tape; 3520 CW.

2. Width: 2 inches (50 mm).
3. Thickness: 3.7 mils (0.093 mm).
4. Adhesion: 100 ounces force/inch (1.1 N/mm) in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch (6.2 N/mm) in width.

2.12 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

a. ITW Insulation Systems; Gerrard Strapping and Seals.
b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch (0.38 mm) thick, 1/2 inch (13 mm), 3/4 inch (19 mm) wide with wing seal or closed seal.
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch (0.51 mm) thick, 1/2 inch (13 mm) 3/4 inch (19 mm) wide with wing seal or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) or 0.135-inch- (3.5-mm-) diameter shank, length to suit depth of insulation indicated.

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; CWP-1.
2) GEMCO; CD.
3) Midwest Fasteners, Inc.; CD.
4) Nelson Stud Welding; TPA, TPC, and TPS.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-) or 0.135-inch- (3.5- mm-) diameter shank, length to suit depth of insulation indicated with integral 1-1/2- inch (38-mm) galvanized carbon-steel washer.

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; CHP-1.
2) GEMCO; Cupped Head Weld Pin.
3) Midwest Fasteners, Inc.; Cupped Head.
4) Nelson Stud Welding; CHP.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
2) GEMCO; Perforated Base.
3) Midwest Fasteners, Inc.; Spindle.

b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
c. Spindle: Copper or zinc-coated, low-carbon steel, Aluminum, or Stainless steel, fully annealed, 0.106-inch (2.6-mm) diameter shank, length to suit depth of insulation indicated.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, provide one of the following:

1) GEMCO; Nylon Hangers.
2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.

b. Baseplate: Perforated, nylon sheet, 0.030 inch (0.76 mm) thick by 1-1/2 inches (38 mm) in diameter.
c. Spindle: Nylon, 0.106-inch- (2.6-mm) diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches (63 mm).
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; Tactoo Self-Adhering Insul-Hangers.
2) GEMCO; Peel & Press.
3) Midwest Fasteners, Inc.; Self Stick.

b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch (0.76 mm) thick by 2 inches (50 mm) square.
c. Spindle: Copper- or zinc-coated, low-carbon steel, Aluminum, or Stainless steel, fully annealed, 0.106-inch- (2.6-mm-) diameter shank, length to suit depth of insulation indicated.
d. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick, galvanized-steel, aluminum, or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; RC-150.
2) GEMCO; R-150.
3) Midwest Fasteners, Inc.; WA-150.
4) Nelson Stud Welding; Speed Clips.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-

mm-) thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) GEMCO.
2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- (19-mm-) wide, stainless steel or Monel.

D. Wire: 0.080-inch (2.0-mm) nickel-copper alloy, 0.062-inch (1.6-mm) soft-annealed, stainless steel, or 0.062-inch (1.6-mm) soft-annealed, galvanized steel.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. C & F Wire.

2.13 CORNER ANGLES

A. PVC Corner Angles: 30 mils (0.8 mm) thick, minimum 1 by 1 inch (25 by 25 mm), PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm), aluminum according to ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch (0.61 mm) thick, minimum 1 by 1 inch (25 by 25 mm), stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches (50 mm) o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches (50 mm).
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches (50mm).

1. Comply with requirements in Section 078413 "Penetration Firestopping" and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches (50 mm).
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
    b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward- clinching staples, 1 inch (25 mm) o.c. Install vapor barrier consisting of factory- or field- applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor- barrier seal.
b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches (75 mm).

5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches (450 mm) o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- (150-mm-) wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches (150 mm) o.c.

3.6 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch (50-mm) overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- (1.6-mm-) thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch (38-mm) laps at longitudinal seams and 3-inch- (75-mm-) wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch (25-mm) overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant

recommended by insulation manufacturer. Secure jacket with stainless- steel bands 12 inches (300 mm) o.c. and at end joints.

3.7 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 078413 "Penetration Firestopping."

3.8 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.10 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed, Type I, commercial, kitchen hood exhaust.
6. Indoor, exposed, Type I, commercial, kitchen hood exhaust.
7. Indoor, concealed oven and warewash exhaust.
8. Indoor, exposed oven and warewash exhaust.
9. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
10. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
11. Outdoor, concealed supply and return.
12. Outdoor, exposed supply and return.

B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.11 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, or non-occupied space supply-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.

B. Concealed, or non-occupied space outdoor-air duct insulation shall be the following:
1. Mineral-Fiber Blanket: 2 inches (50 mm) thick and 0.75-lb/cu. ft. (12-kg/cu. m) nominal density.

C. Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated double wall, Metalbestos style, as required to achieve 2-hour fire rating.

3.12 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.

B. All exterior supply and return ductwork shall be double wall duct insulated to meet ASHRAE 90.1.

3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Exposed:

1. PVC: 20 mils (0.5 mm) thick.
2. Aluminum Smooth: 0.016 inch (0.41 mm) thick.

3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed:

1. PVC: 20 mils (0.5 mm) thick.
2. Aluminum, Smooth: 0.020 inch (0.51 mm) thick.

D. Ducts and Plenums, Exposed, up to 48 Inches (1200 mm) in Diameter or with Flat Surfaces up to 72 Inches (1800 mm):

1. Aluminum, Smooth: 0.016 inch (0.41 mm) thick.
2. Painted Aluminum, Smooth: 0.016 inch (0.41 mm) thick.
3. Stainless Steel, Type 304 or Type 316, Smooth 2B Finish: 0.016 inch (0.41 mm) thick.

E. Ducts and Plenums, Exposed, Larger Than 48 Inches (1200 mm) in Diameter or with Flat Surfaces Larger Than 72 Inches (1800 mm):

1. Painted Aluminum, Smooth with 1-1/4-Inch- (32-mm-) Deep Corrugations thick.
2. Stainless Steel, Type 304 or Type 316, Smooth, with 1-1/4- Inch- (32-mm-) Deep Corrugations thick.

END OF SECTION

SECTION 230800 - COMMISSIONING OF HVAC SYSTEMS

PART 1 – GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
1. Provide Payment and Performance Bonds for the full value of their Subcontract.
2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
1. Comply with the Instructions to Bidders.
2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
FILED SUBCONTRACTOR'S BID FOR SECTION:
23 08 00 – COMMISSIONING OF HVAC SYSTEMS

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
1. All subcontractors to the Filed Subcontractor, whose work is:
a. Valued at $10,000 or more.
2. The contract sum for each subcontractor required to be listed.
a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
4. Comply with the applicable General Laws and the following:
a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

	Class of Work	Specification section number and name
a.	None.	None.

A. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. M1.00 – Mechanical Notes
2. M1.01 – Mechanical Details
3. M1.02 – Mechanical Specifications
4. M1.03 – Mechanical Zoning Plan
5. M2.00 – Mechanical Floor Plan
6. M2.01 – Mechanical Ventilation/Heating Plan
7. M2.02 – Mechanical Roof Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 23 00 00 – Common Work Results for HVAC
2. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
3. Section 23 05 48 – Vibration and Controls for HVAC Piping and Equipment
4. Section 23 05 53 – Identification for HVAC Piping and Equipment
5. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
6. Section 23 07 13 – Duct Insulation
7. Section 23 08 00 – Commissioning of HVAC
8. Section 23 09 00 – Instrumentation and Controls for HVAC
9. Section 23 31 13 – Metal Ducts
10. Section 23 33 00 – Air Duct Accessories
11. Section 23 34 23 – HVAC Power Ventilators
12. Section 23 37 13 – Diffusers, Registers, and Grilles
13. Section 23 37 23 – HVAC Gravity Ventilators
14. Section 23 34 00 – Particulate Air Filtration
15. Section 23 72 00 – Air-to-Air Energy Recovery Ventilator
16. Section 23 74 16 – Package Rooftop Air Conditioning Units
17. Section 23 82 39 – Unit Heaters

B. Alternates: None.

1.3 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 23.

B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIRMENTS.

1.4 RELATED WORK

A. Section 01 00 00 GENERAL REQUIREMENTS.

B. Section 01 33 00 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

C. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

D. Section 23 05 41 NOISE AND VIBRATION CONTROL for HVAC PIPING AND EQUIPMENT.

E. Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC.

F. Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

1.5 SUMMARY

A. This Section includes requirements for commissioning the HVAC systems of the related subsystems and equipment. This Section supplements the general requirements specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

B. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more details regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.6 DEFINITIONS

A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.7 COMMISSIONED SYSTEMS

A. Commissioning of a system or systems specified in Division 23 is part of the construction process. Documentation and testing of these systems, as well as training of the Operation and Maintenance personnel in accordance with the requirements of Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and of Division 23, is required in cooperation with the Commissioning Agent.

B. The Facility HVAC systems commissioning will include the systems listed in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

1.8 SUBMITTALS

A. The commissioning process requires review of selected Submittals that pertain to the systems to be commissioned. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the engineer prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.

B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

1.9 APPLICABLE PUBLICATIONS

A. The following publications form a part of this specification to the extent indicated by the reference thereto. In text the publications are referenced to by the acronym of the organization.

B. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE):

HANDBOOK ..... HVAC Applications ASHRAE Handbook, Chapter 39, Testing, Adjusting, and Balancing, Chapter 44, HVAC Commissioning and Chapter 49, Sound and Vibration Control

HANDBOOK ..... HVAC Fundamentals ASHRAE Handbook, Chapter 8, Sound and Vibration

C. Associated Air Balance Council (AABC):

7th Edition ..... AABC National Standards for Total System Balance

D. National Environmental Balancing Bureau (NEBB):

9th Edition ..... Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems

3rd Edition ..... Procedural Standards for the Measurement of Sound and Vibration

2nd Edition ..... Standard for Whole Building Technical Commissioning of New Construction

F. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

... . HVAC Duct Construction Standard – Metal and Flexible Duct

3rd Edition ..... HVAC Systems Testing, Adjusting and Balancing

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONSTRUCTION INSPECTIONS

A. Commissioning of HVAC systems will require inspection of individual elements of the HVAC systems construction throughout the construction period. The Contractor shall coordinate with the Commissioning Agent in accordance with Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and the Commissioning plan to schedule HVAC systems inspections as required to support the Commissioning Process.

3.2 PRE-FUNCTIONAL CHECKLISTS

A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment

installation. Refer to Sections 23 05 41 NOISE AND VIBRATION CONTROL for HVAC PIPING AND EQUIPMENT, Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC and Section 23 09 23 DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC requirements. The Contractor shall complete the checklists. Completed checklists shall be submitted to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.3 CONTRACTORS TESTS

A. Contractor tests as required by other sections of Division 23 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. All testing shall be incorporated into the project schedule. Contractor shall provide no less than 7 calendar days' notice of testing. The Commissioning Agent will witness selected Contractor tests at the sole discretion of the Commissioning Agent. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.4 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:

A. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Resident Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional requirements.

3.5 TRAINING OF PERSONNEL

A. Training of the operation and maintenance personnel is required in cooperation with the Resident Engineer and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. Contractor shall submit training agendas and trainer resumes in accordance with the requirements of Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The instruction shall be scheduled in coordination with the VA Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 23 Sections for additional Contractor training requirements.

END OF SECTION

SECTION 230900 - INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 – GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
1. Provide Payment and Performance Bonds for the full value of their Subcontract.
2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
1. Comply with the Instructions to Bidders.
2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
FILED SUBCONTRACTOR'S BID FOR SECTION:
23 09 00 – INSTRUMENTATION AND CONTROL FOR HVAC

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
1. All subcontractors to the Filed Subcontractor, whose work is:
a. Valued at $10,000 or more.
2. The contract sum for each subcontractor required to be listed.
a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
4. Comply with the applicable General Laws and the following:
a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

	Class of Work	Specification section number and name
a.	None.	None.

A. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. M1.00 – Mechanical Notes
2. M1.01 – Mechanical Details
3. M1.02 – Mechanical Specifications
4. M1.03 – Mechanical Zoning Plan
5. M2.00 – Mechanical Floor Plan
6. M2.01 – Mechanical Ventilation/Heating Plan
7. M2.02 – Mechanical Roof Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 23 00 00 – Common Work Results for HVAC
2. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
3. Section 23 05 48 – Vibration and Controls for HVAC Piping and Equipment
4. Section 23 05 53 – Identification for HVAC Piping and Equipment
5. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
6. Section 23 07 13 – Duct Insulation
7. Section 23 08 00 – Commissioning of HVAC
8. Section 23 09 00 – Instrumentation and Controls for HVAC
9. Section 23 31 13 – Metal Ducts
10. Section 23 33 00 – Air Duct Accessories
11. Section 23 34 23 – HVAC Power Ventilators
12. Section 23 37 13 – Diffusers, Registers, and Grilles
13. Section 23 37 23 – HVAC Gravity Ventilators
14. Section 23 34 00 – Particulate Air Filtration
15. Section 23 72 00 – Air-to-Air Energy Recovery Ventilator
16. Section 23 74 16 – Package Rooftop Air Conditioning Units
17. Section 23 82 39 – Unit Heaters

B. Alternates: None.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.4 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

1.5 DEFINITIONS

A. DDC: Direct digital control.

B. I/O: Input/output.

C. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.

D. MS/TP: Master slave/token passing.

E. PC: Personal computer.

F. PID: Proportional plus integral plus derivative.

G. RTD: Resistance temperature detector.

1.6 SYSTEM PERFORMANCE

A. Comply with the following performance requirements:

1. Graphic Display: Display graphic with minimum 20 dynamic points with current data within 10 seconds.
2. Graphic Refresh: Update graphic with minimum 20 dynamic points with current data within 8 seconds.
3. Object Command: Reaction time of less than two seconds between operator command of a binary object and device reaction.
4. Object Scan: Transmit change of state and change of analog values to control units or workstation within six seconds.
5. Alarm Response Time: Annunciate alarm at workstation within 45 seconds. Multiple workstations must receive alarms within five seconds of each other.
6. Program Execution Frequency: Run capability of applications as often as five seconds, but selected consistent with mechanical process under control.
7. Performance: Programmable controllers shall execute DDC PID control loops, and scan and update process values and outputs at least once per second.
8. Reporting Accuracy and Stability of Control: Report values and maintain measured variables within tolerances as follows:
   a. Space Temperature: Plus or minus 1 deg F (0.5 deg C).
   b. Ducted Air Temperature: Plus or minus 1 deg F (0.5 deg C).
   c. Outside Air Temperature: Plus or minus 2 deg F (1.0 deg C).
   d. Dew Point Temperature: Plus or minus 3 deg F (1.5 deg C).
   e. Temperature Differential: Plus or minus 0.25 deg F (0.15 deg C).
   f. Relative Humidity: Plus or minus 5 percent.
   g. Airflow (Terminal): Plus or minus 10 percent of full scale.

h. Air Pressure (Ducts): Plus or minus 0.1-inch wg (25 Pa).
i. Electrical: Plus or minus 5 percent of reading.

1.7 ACTION SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
2. Control System Software: Include technical data for operating system software, operator interface, color graphics, and other third-party applications.
3. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
3. Wiring Diagrams: Power, signal, and control wiring.
4. Details of control panel faces, including controls, instruments, and labeling.
5. Written description of sequence of operation.
6. Schedule of dampers including size, leakage, and flow characteristics.
7. Schedule of valves including flow characteristics.
8. DDC System Hardware:

a. Wiring diagrams for control units with termination numbers.
b. Schematic diagrams and floor plans for field sensors and control hardware.
c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.

9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
10. Controlled Systems:

a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
c. Written description of sequence of operation including schematic diagram.

d. Points list.

C. Samples for Verification: For each color required, of each type of thermostat[**or sensor**] cover.

1.8 INFORMATIONAL SUBMITTALS

A. Data Communications Protocol Certificates: Certify that each proposed DDC system component complies with ASHRAE 135.

B. Qualification Data: For manufacturer.

C. Field quality-control test reports.

1.9 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For HVAC instrumentation and control system to include in emergency, operation, and maintenance manuals. Include the following:

1. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.

2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

B. Software and Firmware Operational Documentation: Include the following:

1. Software operating and upgrade manuals.
2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.
5. Software license required by and installed for DDC workstations and control systems.

1.10 QUALITY ASSURANCE

A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.

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.

C. Comply with ASHRAE 135 for DDC system components.

1.11 DELIVERY, STORAGE, AND HANDLING

A. System Software: Update to latest version of software at Project completion.

1.12 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate supply of conditioned electrical branch circuits for control units and operator workstation.

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 CONTROL SYSTEM

A. Manufacturers:

1. Johnson Controls, Inc.; Controls Group.

B. Control system shall consist of sensors, indicators, actuators, final control elements, interface equipment, other apparatus, accessories, and software connected to distributed controllers operating in multiuser, multitasking environment on token-passing network and programmed to control mechanical systems. An operator workstation permits interface with the network via dynamic color graphics with each mechanical system, building floor plan, and control device depicted by point-and-click graphics.

2.3 DDC EQUIPMENT

A. Operator Workstation: Bring operating system up to current revision.

B. Diagnostic Terminal Unit: Portable notebook-style, PC-based microcomputer terminal capable of accessing system data by connecting to system network with minimum configuration as follows:
   1. Verify requirements per project.

C. Control Units: Modular, comprising processor board with programmable, nonvolatile, random- access memory; local operator access and display panel; integral interface equipment; and backup power source.

   1. Units monitor or control each I/O point; process information; execute commands from other control units, devices, and operator stations; and download from or upload to operator workstation or diagnostic terminal unit.
   2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

      a. Global communications.
      b. Discrete/digital, analog, and pulse I/O.
      c. Monitoring, controlling, or addressing data points.
      d. Software applications, scheduling, and alarm processing.
      e. Testing and developing control algorithms without disrupting field hardware and controlled environment.

   3. Standard Application Programs:

      a. Electric Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, night setback/setup, on-off control with differential sequencing, staggered start, antishort cycling, PID control, DDC with fine tuning, and trend logging.
      b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy switchover.
      c. Remote communications.
      d. Maintenance management.
      e. Units of Measure: Inch-pound and SI (metric).

   4. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.

D. Local Control Units: Modular, comprising processor board with electronically programmable, nonvolatile, read-only memory; and backup power source.

   1. Units monitor or control each I/O point, process information, and download from or upload to operator workstation or diagnostic terminal unit.
   2. Stand-alone mode control functions operate regardless of network status. Functions include the following:

      a. Global communications.

b. Discrete/digital, analog, and pulse I/O.
c. Monitoring, controlling, or addressing data points.

3. Local operator interface provides for download from or upload to operator workstation or diagnostic terminal unit.

E. I/O Interface: Hardwired inputs and outputs may tie into system through controllers. Protect points so that shorting will cause no damage to controllers.

1. Binary Inputs: Allow monitoring of on-off signals without external power.
2. Pulse Accumulation Inputs: Accept up to 10 pulses per second.
3. Analog Inputs: Allow monitoring of low-voltage (0- to 10-V dc), current (4 to 20 mA), or resistance signals.
4. Binary Outputs: Provide on-off or pulsed low-voltage signal, selectable for normally open or normally closed operation
5. Analog Outputs: Provide modulating signal, either low voltage (0- to 10-V dc) or current (4 to 20 mA)
6. Tri-State Outputs: Provide two coordinated binary outputs for control of three-point, floating-type electronic actuators.
7. Universal I/Os: Provide software selectable binary or analog outputs.

F. Power Supplies: Transformers with Class 2 current-limiting type or overcurrent protection; limit connected loads to 80 percent of rated capacity. DC power supply shall match output current and voltage requirements and be full-wave rectifier type with the following:

1. Output ripple of 5.0 mV maximum peak to peak.
2. Combined 1 percent line and load regulation with 100-mic.sec. response time for 50 percent load changes.
3. Built-in overvoltage and overcurrent protection and be able to withstand 150 percent overload for at least 3 seconds without failure.

2.4 UNITARY CONTROLLERS

A. Unitized, capable of stand-alone operation with sufficient memory to support its operating system, database, and programming requirements, and with sufficient I/O capacity for the application.

1. Configuration: Local keypad and display; diagnostic LEDs for power, communication, and processor; wiring termination to terminal strip or card connected with ribbon cable; memory with bios; and 72-hour battery backup.
2. Operating System: Manage I/O communication to allow distributed controllers to share real and virtual object information and allow central monitoring and alarms. Perform scheduling with real-time clock. Perform automatic system diagnostics; monitor system and report failures.
3. ASHRAE 135 Compliance: Communicate using read (execute and initiate) and write (execute and initiate) property services defined in ASHRAE 135. Reside on network using MS/TP datalink/physical layer protocol and have service communication port for connection to

diagnostic terminal unit.
4. Enclosure: Dustproof rated for operation at 32 to 120 deg F (0 to 50 deg C).

2.5 ALARM PANELS

A. Unitized cabinet with suitable brackets for wall or floor mounting. Fabricate of 0.06-inch- (1.5- mm-) thick, furniture-quality steel or extruded-aluminum alloy, totally enclosed, with hinged doors and keyed lock and with manufacturer's standard shop-painted finish.

B. Indicating light for each alarm point, single horn, acknowledge switch, and test switch, mounted on hinged cover.

1. Alarm Condition: Indicating light flashes and horn sounds.
2. Acknowledge Switch: Horn is silent and indicating light is steady.
3. Alarm Condition Cleared: System is reset and indicating light is extinguished.
4. Contacts in alarm panel allow remote monitoring by independent alarm company.

2.6 ANALOG CONTROLLERS

A. Step Controllers: 6- or 10-stage type, with heavy-duty switching rated to handle loads and operated by electric motor.

B. Electric, Outdoor-Reset Controllers: Remote-bulb or bimetal rod-and-tube type, proportioning action with adjustable throttling range, adjustable set point, scale range minus 10 to plus 70 deg F (minus 23 to plus 21 deg C), and single- or double-pole contacts.

C. Electronic Controllers: Wheatstone-bridge-amplifier type, in steel enclosure with provision for remote-resistance readjustment. Identify adjustments on controllers, including proportional band and authority.

1. Single controllers can be integral with control motor if provided with accessible control readjustment potentiometer.

D. Fan-Speed Controllers: Solid-state model providing field-adjustable proportional control of motor speed from maximum to minimum of 55 percent and on-off action below minimum fan speed. Controller shall briefly apply full voltage, when motor is started, to rapidly bring motor up to minimum speed. Equip with filtered circuit to eliminate radio interference.

E. Receiver Controllers: Single- or multiple-input models with control-point adjustment, direct or reverse acting with mechanical set-point adjustment with locking device, proportional band adjustment, authority adjustment, and proportional control mode.

1. Remote-control-point adjustment shall be plus or minus 20 percent of sensor span, input signal of 3 to 13 psig (21 to 90 kPa).
2. Proportional band shall extend from 2 to 20 percent for 5 psig (35 kPa).

3. Authority shall be 20 to 200 percent.
4. Air-supply pressure of 18 psig (124 kPa), input signal of 3 to 15 psig (21 to 103 kPa), and output signal of zero to supply pressure.

2.7 ELECTRONIC SENSORS

A. Description: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.

B. Thermistor Temperature Sensors and Transmitters:

1. Manufacturers:

   a. BEC Controls Corporation.
   b. Ebtron, Inc.
   c. Heat-Timer Corporation.
   d. I.T.M. Instruments Inc.
   e. MAMAC Systems, Inc.
   f. RDF Corporation.

2. Accuracy: Plus or minus 0.5 deg F (0.3 deg C) at calibration point.
3. Wire: Twisted, shielded-pair cable.
4. Insertion Elements in Ducts: Single point, use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft.
5. Averaging Elements in Ducts: use where prone to temperature stratification or where ducts are larger than 10 sq. ft. (1 sq. m).
6. Room Sensor Cover Construction: Manufacturer's standard locking covers.

   a. Set-Point Adjustment: Exposed
   b. Set-Point Indication: Exposed.
   c. Thermometer: Exposed.
   d. Orientation: Vertical/Horizontal.

7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
8. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

C. RTDs and Transmitters:

1. Manufacturers:

   a. BEC Controls Corporation.
   b. MAMAC Systems, Inc.
   c. RDF Corporation.

2. Accuracy: Plus or minus 0.2 percent at calibration point.

3. Wire: Twisted, shielded-pair cable.
4. Insertion Elements in Ducts: Single point; use where not affected by temperature stratification or where ducts are smaller than 9 sq. ft. (0.84 sq. m).
5. Averaging Elements in Ducts: use where prone to temperature stratification or where ducts are larger than 9 sq. ft. (0.84 sq. m); length as required.
6. Room Sensor Cover Construction: Manufacturer's standard locking covers.

    a. Set-Point Adjustment: Exposed.
    b. Set-Point Indication: Exposed.
    c. Thermometer: Exposed.
    d. Orientation: Vertical/Horizontal.

7. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight.
8. Room Security Sensors: Stainless-steel cover plate with insulated back and security screws.

D. Humidity Sensors: Bulk polymer sensor element.

1. Manufacturers:

    a. BEC Controls Corporation.
    b. General Eastern Instruments.
    c. MAMAC Systems, Inc.
    d. ROTRONIC Instrument Corp.
    e. TCS/Basys Controls.
    f. Vaisala.

2. Accuracy: 5 percent full range with linear output.
3. Room Sensor Range: 20 to 80 percent relative humidity.
4. Room Sensor Cover Construction: Manufacturer's standard locking covers.

    a. Set-Point Adjustment: Exposed.
    b. Set-Point Indication: Exposed.
    c. Thermometer: Exposed.
    d. Orientation: Vertical/Horizontal.

5. Duct Sensor: 20 to 80 percent relative humidity range with element guard and mounting plate.
6. Outside-Air Sensor: 20 to 80 percent relative humidity range with mounting enclosure, suitable for operation at outdoor 4
7. Duct and Sensors: With element guard and mounting plate, range of 0 to 100 percent relative humidity.

E. Pressure Transmitters/Transducers:

1. Manufacturers:

a. BEC Controls Corporation.
b. General Eastern Instruments.
c. MAMAC Systems, Inc.
d. ROTRONIC Instrument Corp.
e. TCS/Basys Controls.
f. Vaisala.

2. Static-Pressure Transmitter: Nondirectional sensor with suitable range for expected input, and temperature compensated.

a. Accuracy: 2 percent of full scale with repeatability of 0.5 percent.
b. Output: 4 to 20 mA.
c. Building Static-Pressure Range: 0- to 0.25-inch wg (0 to 62 Pa).
d. Duct Static-Pressure Range: 0- to 5-inch wg (0 to 1240 Pa).

3. Differential-Pressure Switch (Air or Water): Snap acting, with pilot-duty rating and with suitable scale range and differential.

F. Room Sensor Cover Construction: Manufacturer's standard locking covers.

1. Set-Point Adjustment: Exposed.
2. Set-Point Indication: Exposed.
3. Thermometer: Exposed.
4. Orientation: Vertical/Horizontal.

G. Room sensor accessories include the following:

1. Insulating Bases: For sensors located on exterior walls.
2. Adjusting Key: As required for calibration and cover screws.

2.8 STATUS SENSORS

A. Status Inputs for Fans: Differential-pressure switch with pilot-duty rating and with adjustable range of 0- to 5-inch wg (0 to 1240 Pa).

B. Status Inputs for Pumps: Differential-pressure switch with pilot-duty rating and with adjustable pressure-differential range of 8 to 60 psig (55 to 414 kPa), piped across pump.

C. Status Inputs for Electric Motors: Comply with ISA 50.00.01, current-sensing fixed- or split- core transformers with self-powered transmitter, adjustable and suitable for 175 percent of rated motor current.

D. Voltage Transmitter (100- to 600-V ac): Comply with ISA 50.00.01, single-loop, self-powered transmitter, adjustable, with suitable range and 1 percent full-scale accuracy.

E. Power Monitor: 3-phase type with disconnect/shorting switch assembly, listed voltage and current transformers, with pulse kilowatt hour output and 4- to 20-mA kW output, with maximum 2 percent error at 1.0 power factor and 2.5 percent error at 0.5 power factor.

F. Current Switches: Self-powered, solid-state with adjustable trip current, selected to match current and system output requirements.

G. Electronic Valve/Damper Position Indicator: Visual scale indicating percent of travel and 2- to 10-V dc, feedback signal.

1. Manufacturers:

a. BEC Controls Corporation.
b. I.T.M. Instruments Inc.

2.9 FLOW MEASURING STATIONS

A. Duct Airflow Station: Combination of air straightener and multiport, self-averaging pitot tube station.

1. Manufacturers:

a. Air Monitor Corporation.
b. Wetmaster Co., Ltd.

2. Casing: Galvanized-steel frame.
3. Flow Straightener: Aluminum honeycomb, 3/4-inch (20-mm) parallel cell, 3 inches (75 mm) deep.
4. Sensing Manifold: Copper manifold with bullet-nosed static pressure sensors positioned on equal area basis.

2.10 THERMOSTATS

A. Manufacturers:

1. Johnson Controls.

B. Combination Thermostat and Fan Switches: Line-voltage thermostat with push-button or lever-operated fan switch.

1. Label switches FAN ON-OFF.
2. Mount on single electric switch box.

C. Electric, solid-state, microcomputer-based room thermostat with remote sensor.

1. Automatic switching from heating to cooling.
2. Preferential rate control to minimize overshoot and deviation from set point.
3. Set up for four separate temperatures per day.
4. Instant override of set point for continuous or timed period from 1 hour to 31 days.
5. Short-cycle protection.
6. Programming based on every day of week.
7. Selection features include degree F or degree C display, 12- or 24-hour clock, keyboard disable, remote sensor, and fan on-auto.
8. Battery replacement without program loss.
9. Thermostat display features include the following:

a. Time of day.
b. Actual room temperature.
c. Programmed temperature.
d. Programmed time.
e. Duration of timed override.
f. Day of week.
g. System mode indications include "heating," "off," "fan auto," and "fan on."

2.11 HUMIDISTATS

A. Manufacturers:

1. Johnson Controls.
2. Honeywell.

B. Room Humidistats: Wall-mounting, proportioning type with adjustable throttling range, 20 to 80 percent operating range, and cover matching room thermostat cover.

C. Duct-Mounting Humidistats: Electric insertion, 2-position type with adjustable, 2 percent throttling range, 20 to 80 percent operating range, and single- or double-pole contacts.

2.12 ACTUATORS

A. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.

1. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."
2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback

potentiometer.

3. Nonspring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
4. Spring-Return Motors for Valves Larger Than NPS 2-1/2 (DN 65): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).
5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running torque of 150 in. x lbf (16.9 N x m) and breakaway torque of 300 in. x lbf (33.9 N x m).
6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft. (2.3 sq. m): Size for running and breakaway torque of 150 in. x lbf (16.9 N x m).

B. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.

1. Manufacturers:

   a. Belimo Aircontrols (USA), Inc.

2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
3. Dampers: Size for running torque calculated as follows:

   a. Parallel-Blade Damper with Edge Seals: 7 inch-lb/sq. ft. (86.8 kg-cm/sq. m) of damper.
   b. Opposed-Blade Damper with Edge Seals: 5 inch-lb/sq. ft. (62 kg-cm/sq. m) of damper.
   c. Parallel-Blade Damper without Edge Seals: 4 inch-lb/sq. ft (49.6 kg-cm/sq. m) of damper.
   d. Opposed-Blade Damper without Edge Seals: 3 inch-lb/sq. ft. (37.2 kg-cm/sq. m) of damper.
   e. Dampers with 2- to 3-Inch wg (500 to 750 Pa) of Pressure Drop or Face Velocities of 1000 to 2500 fpm (5 to 13 m/s): Increase running torque by 1.5.
   f. Dampers with 3- to 4-Inch wg (750 to 1000 Pa) of Pressure Drop or Face Velocities of 2500 to 3000 fpm (13 to 15 m/s): Increase running torque by 2.0.

4. Coupling: V-bolt and V-shaped, toothed cradle.
5. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
6. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on nonspring-return actuators.
7. Power Requirements (Two-Position Spring Return): 24 V.
8. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
9. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
10. Temperature Rating: Minus 22 to plus 122 deg F (Minus 30 to plus 50 deg C).
11. Temperature Rating (Smoke Dampers): Minus 22 to plus 250 deg F (Minus 30 to plus 121 deg C).
12. Run Time: 30 seconds.

2.13 DAMPERS

A. Manufacturers:

1. Trane
2. Air Balance Inc.
3. Don Park Inc.; Autodamp Div.
4. TAMCO (T. A. Morrison & Co. Inc.).
5. United Enertech Corp.
6. Vent Products Company, Inc.

B. Dampers: AMCA-rated, opposed-blade design; 0.108-inch- (2.8-mm-) minimum thick, galvanized-steel or 0.125-inch- (3.2-mm-) minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- (1.6-mm-) thick galvanized steel with maximum blade width of 8 inches (200 mm) and length of 48 inches (1220 mm).

1. Secure blades to 1/2-inch- (13-mm-) diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).
3. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. (50 L/s per sq. m) of damper area, at differential pressure of 4-inch wg (1000 Pa) when damper is held by torque of 50 in. x lbf (5.6 N x m); when tested according to AMCA 500D.

2.14 CONTROL CABLE

A. Electronic and fiber-optic cables for control wiring are specified in Section 271500 "Communications Horizontal Cabling."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that power supply is available to control units and operator workstation.

B. Verify that pneumatic piping and duct-, pipe-, and equipment-mounted devices are installed before proceeding with installation.

3.2 INSTALLATION

A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.

B. Connect and configure equipment and software to achieve sequence of operation specified.

C. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches (1220 mm) above the floor.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

D. Install guards on thermostats in the following locations:

1. Entrances.
2. Public areas.
3. Where indicated.

E. Install automatic dampers according to Section 233300 "Air Duct Accessories."

F. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

G. Install labels and nameplates to identify control components according to Section 230553 "Identification for HVAC Piping and Equipment."

H. Install duct volume-control dampers according to Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts."

I. Install electronic and fiber-optic cables according to Section 271500 "Communications Horizontal Cabling."

J. Install tubing with sufficient slack and flexible connections to allow for vibration of piping and equipment.

3.3 ELECTRICAL WIRING AND CONNECTION INSTALLATION

A. Install raceways, boxes, and cabinets according to Section 260533 "Raceways and Boxes for Electrical Systems."

B. Install building wire and cable according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Install signal and communication cable according to Section 271500 "Communications Horizontal Cabling."

1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
2. Install exposed cable in raceway.
3. Install concealed cable in raceway.

4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

D. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

E. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.

B. DDC Verification:

1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check instrument tubing for proper fittings, slope, material, and support.
5. Check installation of air supply for each instrument.
6. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
7. Check pressure instruments, piping slope, installation of valve manifold, and self- contained pressure regulators.
8. Check temperature instruments and material and length of sensing elements.
9. Check control valves. Verify that they are in correct direction.
10. Check air-operated dampers. Verify that pressure gages are provided and that proper blade alignment, either parallel or opposed, has been provided.
11. Check DDC system as follows:

    a. Verify that DDC controller power supply is from emergency power supply, if applicable.
    b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
    c. Verify that spare I/O capacity has been provided.
    d. Verify that DDC controllers are protected from power supply surges.

C. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.5 ADJUSTING

A. Calibrating and Adjusting:

1. Calibrate instruments.

2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:

    a. Check analog inputs at 0, 50, and 100 percent of span.
    b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
    c. Check digital inputs using jumper wire.
    d. Check digital outputs using ohmmeter to test for contact making or breaking.
    e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.

5. Flow:

    a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
    b. Manually operate flow switches to verify that they make or break contact.

6. Pressure:

    a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
    b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.

7. Temperature:

    a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
    b. Calibrate temperature switches to make or break contacts.

8. Stroke and adjust control valves and dampers without positioners, following the manufacturer's recommended procedure, so that valve or damper is 100 percent open and closed.
9. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
10. Provide diagnostic and test instruments for calibration and adjustment of system.
11. Provide written description of procedures and equipment for calibrating each type of

instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature and humidity set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to three visits to Project during other than normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Section 017900 "Demonstration and Training."

END OF SECTION

SECTION 233113 - METAL DUCTS

PART 1 – GENERAL
[[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
1. Provide Payment and Performance Bonds for the full value of their Subcontract.
2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
1. Comply with the Instructions to Bidders.
2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
FILED SUBCONTRACTOR'S BID FOR SECTION:
23 31 13 – METAL DUCTS

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
1. All subcontractors to the Filed Subcontractor, whose work is:
a. Valued at $10,000 or more.
2. The contract sum for each subcontractor required to be listed.
a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
4. Comply with the applicable General Laws and the following:
a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

	Class of Work	Specification section number and name
a.	None.	None.

A. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. M1.00 – Mechanical Notes
2. M1.01 – Mechanical Details
3. M1.02 – Mechanical Specifications
4. M1.03 – Mechanical Zoning Plan
5. M2.00 – Mechanical Floor Plan
6. M2.01 – Mechanical Ventilation/Heating Plan
7. M2.02 – Mechanical Roof Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 23 00 00 – Common Work Results for HVAC
2. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
3. Section 23 05 48 – Vibration and Controls for HVAC Piping and Equipment
4. Section 23 05 53 – Identification for HVAC Piping and Equipment
5. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
6. Section 23 07 13 – Duct Insulation
7. Section 23 08 00 – Commissioning of HVAC
8. Section 23 09 00 – Instrumentation and Controls for HVAC
9. Section 23 31 13 – Metal Ducts
10. Section 23 33 00 – Air Duct Accessories
11. Section 23 34 23 – HVAC Power Ventilators
12. Section 23 37 13 – Diffusers, Registers, and Grilles
13. Section 23 37 23 – HVAC Gravity Ventilators
14. Section 23 34 00 – Particulate Air Filtration
15. Section 23 72 00 – Air-to-Air Energy Recovery Ventilator
16. Section 23 74 16 – Package Rooftop Air Conditioning Units
17. Section 23 82 39 – Unit Heaters

B. Alternates: None.

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. Single-wall rectangular ducts and fittings.
2. Single-wall round and flat-oval ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.

B. Related Sections:

1. Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 23 33 00 "Air Duct Accessories" for dampers, sound-control devices, duct- mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.

12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations for selecting hangers and supports.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.
f. Perimeter moldings.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal

and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct- support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct- support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Lindab Inc.
    b. McGill AirFlow LLC.
    c. SEMCO Incorporated.
    d. Sheet Metal Connectors, Inc.
    e. Spiral Manufacturing Co., Inc.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches (1524 mm) in Diameter: Flanged.

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class,

applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches (2286 mm) in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches (1830 mm) in width (major dimension) with butt-welded longitudinal seams.

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60 (Z180).
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. PVC-Coated, Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60 (Z180).
2. Minimum Thickness for Factory-Applied PVC Coating: 4 mils (0.10 mm) thick on sheet metal surface of ducts and fittings exposed to corrosive conditions, and minimum 1 mil (0.025 mm) thick on opposite surface.
3. Coating Materials: Acceptable to authorities having jurisdiction for use on ducts listed and labeled by an NRTL for compliance with UL 181, Class 1.

D. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

E. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

F. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

G. Factory- or Shop-Applied Antimicrobial Coating:

1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.
4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
5. Shop-Applied Coating Color: Black/White.

H. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

I. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.4 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 inches (76 mm).
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.

3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.
10. Maximum Static-Pressure Class: 10-inch wg (2500 Pa), positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and shall be rated for10-inch wg (2500-Pa) static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.5 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round and flat-oval ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm).

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Outdoor, Supply-Air Ducts: Seal Class A.
3. Outdoor, Exhaust Ducts: Seal Class C.
4. Outdoor, Return-Air Ducts: Seal Class C.
5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class B.
6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class A.
7. Unconditioned Space, Exhaust Ducts: Seal Class C.
8. Unconditioned Space, Return-Air Ducts: Seal Class B.
9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg (500 Pa) and Lower: Seal Class C.
10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg (500 Pa): Seal Class B.
11. Conditioned Space, Exhaust Ducts: Seal Class B.
12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m).

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:

    a. Ducts with a Pressure Class Higher Than 3-Inch wg (750 Pa): Test representative duct sections, totaling no less than 25 percent of total installed duct area for each designated pressure class.
    b. Supply Ducts with a Pressure Class of 2-Inch wg (500 Pa) or Higher: Test representative duct sections, totaling no less than 50 percent of total installed duct area for each designated pressure class.
    c. Return Ducts with a Pressure Class of 2-Inch wg (500 Pa) or Higher: Test representative duct sections, totaling no less than 50 percent of total installed duct area for each designated pressure class.
    d. Exhaust Ducts with a Pressure Class of 2-Inch wg (500 Pa)or Higher: Test representative duct sections, totaling no less than 50 percent of total installed duct area for each designated pressure class.

    e. Outdoor Air Ducts with a Pressure Class of 2-Inch wg (500 Pa) or Higher: Test representative duct sections, totaling no less than 50 percent of total installed duct area for each designated pressure class.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being

tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.

6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Test sections of metal duct system for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.8 DUCT CLEANING

A. Clean new and existing duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and

filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.9 START UP

A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.10 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel.

B. Supply Ducts:

1. Ducts Connected to Constant-Volume Air-Handling Units:

a. Pressure Class: Positive 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

2. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive 2-inch wg (500 Pa).

b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

C. Return Ducts:

1. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

2. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 6.

D. Exhaust Ducts:

1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:

a. Pressure Class: Negative 1-inch wg (250 Pa).
b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

2. Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive or negative 2-inch wg (500 Pa).
b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 12.

E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts.
2. PVC-Coated Ducts:

    a. Exposed to Airstream: Match duct material.
    b. Not Exposed to Airstream: Galvanized.

3. Stainless-Steel Ducts:

    a. Exposed to Airstream: Match duct material.
    b. Not Exposed to Airstream: Galvanized.

4. Aluminum Ducts

F. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

    a. Velocity 1000 fpm (5 m/s) or Lower:

        1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
        2) Mitered Type RE 4 without vanes.

    b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s):

        1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
        2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
        3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

    c. Velocity 1500 fpm (7.6 m/s) or Higher:

        1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
        2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
        3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

    a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction

Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3- 1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm (5 m/s) or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm (7.6 m/s) or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
4) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches (305 mm) and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches (356 mm) and Larger in Diameter: Standing seam.

G. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

a. Rectangular Main to Rectangular Branch: 45-degree entry.
b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm (5 m/s) or Lower: 90-degree tap.
b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap.
c. Velocity 1500 fpm (7.6 m/s) or Higher: 45-degree lateral.

END OF SECTION

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 – GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
1. Provide Payment and Performance Bonds for the full value of their Subcontract.
2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
1. Comply with the Instructions to Bidders.
2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
FILED SUBCONTRACTOR'S BID FOR SECTION:
23 33 00 – AIR DUCT ACCESSORIES

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
1. All subcontractors to the Filed Subcontractor, whose work is:
a. Valued at $10,000 or more.
2. The contract sum for each subcontractor required to be listed.
a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
4. Comply with the applicable General Laws and the following:
a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

	Class of Work	Specification section number and name
a.	None.	None.

A. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. M1.00 – Mechanical Notes
2. M1.01 – Mechanical Details
3. M1.02 – Mechanical Specifications
4. M1.03 – Mechanical Zoning Plan
5. M2.00 – Mechanical Floor Plan
6. M2.01 – Mechanical Ventilation/Heating Plan
7. M2.02 – Mechanical Roof Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 23 00 00 – Common Work Results for HVAC
2. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
3. Section 23 05 48 – Vibration and Controls for HVAC Piping and Equipment
4. Section 23 05 53 – Identification for HVAC Piping and Equipment
5. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
6. Section 23 07 13 – Duct Insulation
7. Section 23 08 00 – Commissioning of HVAC
8. Section 23 09 00 – Instrumentation and Controls for HVAC
9. Section 23 31 13 – Metal Ducts
10. Section 23 33 00 – Air Duct Accessories
11. Section 23 34 23 – HVAC Power Ventilators
12. Section 23 37 13 – Diffusers, Registers, and Grilles
13. Section 23 37 23 – HVAC Gravity Ventilators
14. Section 23 34 00 – Particulate Air Filtration
15. Section 23 72 00 – Air-to-Air Energy Recovery Ventilator
16. Section 23 74 16 – Package Rooftop Air Conditioning Units
17. Section 23 82 39 – Unit Heaters

B. Alternates: None.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.4 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Barometric relief dampers.
3. Manual volume dampers.
4. Control dampers.
5. Fire dampers.
6. Ceiling radiation dampers.
7. Smoke dampers.
8. Combination fire and smoke dampers.
9. Corridor dampers.
10. Flange connectors.
11. Duct silencers.
12. Turning vanes.
13. Remote damper operators.
14. Duct-mounted access doors.
15. Flexible connectors.
16. Flexible ducts.
17. Duct security bars.
18. Duct accessory hardware.

B. Related Requirements:

1. Section 233723 "HVAC Gravity Ventilators" for roof-mounted ventilator caps.

2. Section 283111 "Digital, Addressable Fire-Alarm System" for duct-mounted fire and smoke detectors.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Control-damper installations.
d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.

e. Duct security bars.
f. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

B. Source quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60 (Z180).
2. Exposed-Surface Finish: Mill phosphatized.

B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and painted finish for exposed ducts.

C. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B 221 (ASTM B 221M), Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm).

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. American Warming and Ventilating; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. Lloyd Industries, Inc.
6. Nailor Industries Inc.
7. NCA Manufacturing, Inc.
8. Pottorff.
9. Ruskin Company.
10. Vent Products Company, Inc.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 2000 fpm (10 m/s)

D. Maximum System Pressure: 2-inch wg (0.5 kPa).

E. Frame: Hat-shaped, 0.05-inch- (1.3-mm-) thick, galvanized sheet steel, with welded corners or mechanically attached and mounting flange.

F. Blades: Multiple single-piece blades, center pivoted, off-center pivoted, end pivoted, maximum 6-inch (150-mm) width, 0.025-inch- (0.6-mm-) thick, roll-formed aluminum with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Neoprene, mechanically locked.

I. Blade Axles:

1. Material: Galvanized steel or Aluminum.
2. Diameter: 0.20 inch (5 mm).

J. Tie Bars and Brackets: Aluminum or Galvanized steel.

K. Return Spring: Adjustable tension.

L. Bearings: Steel ball or synthetic pivot bushings.

M. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.
5. Screen Mounting: Front mounted in sleeve.
    a. Sleeve Thickness: 20 gage (1.0 mm) minimum.
    b. Sleeve Length: 6 inches (152 mm) minimum.
6. Screen Material: Galvanized steel or Aluminum.
7. Screen Type: Bird.
8. 90-degree stops.

2.4 BAROMETRIC RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. American Warming and Ventilating; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. Lloyd Industries, Inc.
6. Nailor Industries Inc.
7. NCA Manufacturing, Inc.
8. Pottorff.
9. Ruskin Company.
10. Vent Products Company, Inc.

B. Suitable for horizontal or vertical mounting.

C. Maximum Air Velocity: 2000 fpm (10 m/s).

D. Maximum System Pressure: 2-inch wg (0.5 kPa).

E. Frame: Hat-shaped, 0.05-inch- (1.3-mm-) thick, galvanized sheet, 0.063-inch- (1.6-mm-) thick extruded aluminum, with welded corners or mechanically attached and mounting flange.

F. Blades:

1. Multiple, 0.025-inch- (0.6-mm-) thick, roll-formed aluminum.
2. Maximum Width: 6 inches (150 mm).
3. Action: Parallel.
4. Balance: Gravity.
5. Eccentrically pivoted, Off-center pivoted, or End pivoted.

G. Blade Seals: [Vinyl] [Neoprene].

H. Blade Axles: Galvanized steel.

I. Tie Bars and Brackets:

1. Material: Aluminum or Galvanized steel.
2. Rattle free with 90-degree stop.

J. Return Spring: Adjustable tension.

K. Bearings: Synthetic.

L. Accessories:

1. Flange on intake.
2. Adjustment device to permit setting for varying differential static pressures.

2.5 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Air Balance Inc.; a division of Mestek, Inc.
b. American Warming and Ventilating; a division of Mestek, Inc.
c. Flexmaster U.S.A., Inc.
d. McGill AirFlow LLC.
e. Nailor Industries Inc.
f. Pottorff.
g. Ruskin Company.
h. Trox USA Inc.
i. Vent Products Company, Inc.

2. Standard leakage rating with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:

    a. Frame: Hat-shaped,[0.094-inch- (2.4-mm-) thick, galvanized sheet steel.
    b. Mitered and welded corners.
    c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

    a. Multiple or single blade.
    b. Parallel- or opposed-blade design.
    c. Stiffen damper blades for stability.
    d. [Galvanized] [Stainless]-steel, 0.064 inch (1.62 mm) thick.

6. Blade Axles: Galvanized steel.
7. Bearings:

    a. Molded synthetic.
    b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Galvanized steel.

B. Standard, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Air Balance Inc.; a division of Mestek, Inc.
    b. American Warming and Ventilating; a division of Mestek, Inc.
    c. McGill AirFlow LLC.
    d. Nailor Industries Inc.
    e. Pottorff.
    f. Ruskin Company.
    g. Trox USA Inc.
    h. Vent Products Company, Inc.

2. Standard leakage rating with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames: Hat-shaped, 0.10-inch- (2.5-mm-) thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:

a. Multiple or single blade.
b. Parallel- or opposed-blade design.
c. Stiffen damper blades for stability.
d. Roll-Formed Aluminum Blades: 0.10-inch- (2.5-mm-) thick aluminum sheet.
e. Extruded-Aluminum Blades: 0.050-inch- (1.2-mm-) thick extruded aluminum.

6. Blade Axles: Galvanized steel.
7. Bearings:

a. Molded synthetic.
b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Aluminum.

C. Low-Leakage, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Air Balance Inc.; a division of Mestek, Inc.
b. American Warming and Ventilating; a division of Mestek, Inc.
c. McGill AirFlow LLC.
d. Nailor Industries Inc.
e. Pottorff.
f. Ruskin Company.
g. Trox USA Inc.
h. Vent Products Company, Inc.

2. Comply with AMCA 500-D testing for damper rating.
3. Low-leakage rating with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
4. Suitable for horizontal or vertical applications.

5. Frames:

a. Hat, U, or Angle shaped.
b. 0.094-inch- (2.4-mm-) thick, galvanized sheet steel
c. Mitered and welded corners.
d. Flanges for attaching to walls and flangeless frames for installing in ducts.

6. Blades:

a. Multiple or single blade.
b. Parallel- or opposed-blade design.

c. Stiffen damper blades for stability.
d. Galvanized, roll-formed steel, 0.064 inch (1.62 mm) thick.

7. Blade Axles: Galvanized steel.
8. Bearings:

a. Molded synthetic.
b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

9. Blade Seals: Neoprene.
10. Jamb Seals: Cambered aluminum.
11. Tie Bars and Brackets: Galvanized steel or Aluminum.
12. Accessories:

a. Include locking device to hold single-blade dampers in a fixed position without vibration.

D. Low-Leakage, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Air Balance Inc.; a division of Mestek, Inc.
b. American Warming and Ventilating; a division of Mestek, Inc.
c. McGill AirFlow LLC.
d. Nailor Industries Inc.
e. Pottorff.
f. Ruskin Company.
g. Trox USA Inc.
h. Vent Products Company, Inc.

2. Comply with AMCA 500-D testing for damper rating.
3. Low-leakage rating with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
4. Suitable for horizontal or vertical applications.

5. Frames: Hat, U, or Angle-shaped, 0.10-inch- (2.5-mm-) thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
6. Blades:

a. Multiple or single blade.
b. Parallel- or opposed-blade design.
c. Roll-Formed Aluminum Blades: 0.10-inch- (2.5-mm-) thick aluminum sheet.
d. Extruded-Aluminum Blades: 0.050-inch- (1.2-mm-) thick extruded aluminum.

7. Blade Axles: Galvanized steel.
8. Bearings:

    a. Molded synthetic.
    b. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

9. Blade Seals: Neoprene.
10. Jamb Seals: Cambered aluminum.
11. Tie Bars and Brackets: Galvanized steel or Aluminum.
12. Accessories:

    a. Include locking device to hold single-blade dampers in a fixed position without vibration.

E. Jackshaft:

1. Size: 0.5-inch (13-mm) diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

F. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc- plated steel, and a 3/4-inch (19-mm) hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.6 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. Lloyd Industries, Inc.
6. McGill AirFlow LLC.
7. Metal Form Manufacturing, Inc.
8. Nailor Industries Inc.
9. NCA Manufacturing, Inc.
10. Pottorff.
11. Ruskin Company.
12. Vent Products Company, Inc.

13. Young Regulator Company.

B. Low-leakage rating[, with linkage outside airstream,] and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:

1. Hat, U, or Angle shaped.
2. 0.094-inch- (2.4-mm-) thick, galvanized sheet steel
3. Mitered and welded corners.

D. Blades:

1. Multiple blade with maximum blade width of 6 inches (152 mm).
2. Opposed-blade design.
3. [alvanized-steel.
4. 0.064 inch (1.62 mm) thick single skin or 0.0747-inch- (1.9-mm-) thick dual skin.
5. Blade Edging: Closed-cell neoprene.

E. Blade Axles: 1/2-inch- (13-mm-) diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F (minus 40 to plus 93 deg C).

F. Bearings:

1. Molded synthetic.
2. Dampers in ducts with pressure classes of 3-inch wg (750 Pa) or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

2.7 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. Nailor Industries Inc.
6. NCA Manufacturing, Inc.
7. Pottorff.
8. Prefco; Perfect Air Control, Inc.
9. Ruskin Company.

10. Vent Products Company, Inc.
11. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 2000-fpm (10-m/s) velocity.

D. Fire Rating: 1-1/2 and 3 hours.

E. Frame: Curtain type with blades inside airstream, Curtain type with blades outside airstream, Multiple-blade type, Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch- (0.85-mm-) thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: 0.05 (1.3 mm), 0.138 inch (3.5 mm) or 0.39 inch (9.9 mm) thick, as indicated, and of length to suit application.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.024-inch- (0.61-mm) thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- (0.85-mm-) thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Heat-Responsive Device: Replaceable, 165 deg F (74 deg C) and/or 212 deg F (100 deg C) rated, fusible links.

K. Heat-Responsive Device: resettable and replaceable link and switch package, factory installed, 165 deg F (74 deg C) and 212 deg F (100 deg C)] rated.

2.8 CEILING RADIATION DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Nailor Industries Inc.
4. Pottorff.

5. Prefco; Perfect Air Control, Inc.
6. Ruskin Company.
7. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. General Requirements:

1. Labeled according to UL 555C by an NRTL.
2. Comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."

C. Frame: Galvanized sheet steel, round or rectangular, style to suit ceiling construction.

D. Blades: Galvanized sheet steel with refractory insulation.

E. Heat-Responsive Device: Replaceable, 165 deg F (74 deg C) or 212 deg F (100 deg C) rated, fusible links.

F. Fire Rating: 1 or 2 hours.

2.9 SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Greenheck Fan Corporation.
4. Nailor Industries Inc.
5. Pottorff.
6. Ruskin Company.

B. General Requirements: Label according to UL 555S by an NRTL.

C. Smoke Detector: Integral, factory wired for single-point connection.

D. Frame: Hat-shaped, 0.094-inch- (2.4-mm-) thick, galvanized sheet steel, with welded, interlocking, gusseted, or mechanically attached corners and mounting flange.

E. Blades: Roll-formed, horizontal, interlocking or overlapping, 0.034-inch- (0.85-mm-) or 0.063-inch- (1.6-mm) thick, galvanized sheet steel.

F. Leakage: Class I and Class II.

G. Rated pressure and velocity to exceed design airflow conditions.

H. Mounting Sleeve: Factory-installed, 0.039-inch- (1.0-mm-) or 0.05-inch- (1.3-mm-) thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

I. Damper Motors: Modulating or two-position action.

J. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230900 "Instrumentation and Control for HVAC."
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
7. Electrical Connection: 115 V, single phase, 60 Hz.

K. Accessories:

1. Auxiliary switches for signaling, fan control, or position indication.
2. Momentary test switch, Test and reset switches, damper, and remote mounted.

2.10 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Greenheck Fan Corporation.
4. Nailor Industries Inc.
5. Pottorff.
6. Ruskin Company.

B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

C. Closing rating in ducts up to 4-inch wg (1-kPa) static pressure class and minimum 2000-fpm (10-m/s) velocity.

D. Fire Rating: 1-1/2 and 3 hours.

E. Frame: Hat-shaped, 0.094-inch- (2.4-mm-) thick, galvanized sheet steel, with welded, interlocking, gusseted, or mechanically attached corners and mounting flange.

F. Heat-Responsive Device: Resettable or Replaceable, 165 deg F (74 deg C) or 212 deg F (100 deg C) rated, fusible links.

G. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.

H. Smoke Detector: Integral, factory wired for single-point connection.

I. Blades: Roll-formed, horizontal, interlocking or overlapping, 0.063-inch- (1.6-mm-) or 0.034-inch- (0.85-mm-) thick, galvanized sheet steel.

J. Leakage: Class I or Class II.

K. Rated pressure and velocity to exceed design airflow conditions.

L. Mounting Sleeve: Factory-installed, 0.039-inch- (1.0-mm-) or 0.05-inch- (1.3-mm-) thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.

M. Master control panel for use in dynamic smoke-management systems.

N. Damper Motors: Modulating or two-position action.

O. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230900 "Instrumentation and Control for HVAC."
3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running

torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
7. Electrical Connection: 115 V, single phase, 60 Hz.

P. Accessories:

1. Auxiliary switches for signaling, fan control, or position indication.
2. Momentary test switch, Test and reset switches, damper and remote mounted.

2.11 CORRIDOR DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance Inc.; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Nailor Industries Inc.
4. Pottorff.
5. Ruskin Company.

B. General Requirements: Label combination fire and smoke dampers according to UL 555 for 1- hour or 1-1/2-hour rating by an NRTL.

C. Heat-Responsive Device: Replaceable, 165 deg F (74 deg C) or 212 deg F (100 deg C) rated, fusible links.

D. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.

E. Frame: Hat-shaped, 0.094-inch- (2.4-mm-) thick, galvanized sheet steel, with welded, interlocking, gusseted, or mechanically attached corners and mounting flange.

F. Blades: Roll-formed, horizontal, interlocking or overlapping, 0.034-inch- (0.85-mm-) thick, galvanized sheet steel.

G. Mounting Sleeve: Factory-installed, 0.039-inch- (1.0-mm-) or 0.05-inch- (1.3-mm-) thick, galvanized sheet steel; length to suit wall or floor application.

H. Damper Motors: Modulating or two-position action.

I. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230900 "Instrumentation and Control for HVAC."

3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 150 in. x lbf (17 N x m).
5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F (minus 40 deg C).
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft. (2.3 sq. m), size motor for running torque rating of 150 in. x lbf (17 N x m) and breakaway torque rating of 300 in. x lbf (34 N x m).
7. Electrical Connection: 115 V, single phase, 60 Hz.

2.12 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.13 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Elgen Manufacturing.
4. METALAIRE, Inc.
5. SEMCO Incorporated.
6. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces

and fibrous-glass fill.

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

E. Vane Construction: Single wall.

F. Vane Construction: Single wall for ducts up to 48 inches (1200 mm) wide and double wall for larger dimensions.

2.14 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Ductmate Industries, Inc.
4. Elgen Manufacturing.
5. Flexmaster U.S.A., Inc.
6. Greenheck Fan Corporation.
7. McGill AirFlow LLC.
8. Nailor Industries Inc.
9. Pottorff.
10. Ventfabrics, Inc.
11. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2 (7-2M), "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:

a. Double wall, rectangular.
b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
c. Vision panel.
d. Hinges and Latches: 1-by-1-inch (25-by-25-mm)butt or piano hinge and cam latches.
e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

    a. Access Doors Less Than 12 Inches (300 mm) Square: No hinges and two sash locks.
    b. Access Doors up to 18 Inches (460 mm) Square: Two hinges and two sash locks.
    c. Access Doors up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches.
    d. Access Doors Larger Than 24 by 48 Inches (600 by 1200 mm): Four hinges and two compression latches with outside and inside handles.

C. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
2. Door: Single wall with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Factory set at 3.0- to 8.0-inch wg (800 to 2000 Pa).
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

2.15 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Flame Gard, Inc.
3. 3M.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0528-inch (1.3-mm) carbon or 0.0428-inch (1.1-mm) stainless steel.

D. Fasteners: Carbon or Stainless steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F (1093 deg C).

F. Minimum Pressure Rating: 10-inch wg (2500 Pa), positive or negative.

2.16 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Elgen Manufacturing.
4. Ventfabrics, Inc.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches (89 mm) or 5-3/4 inches (146 mm) wide attached to two strips of 2-3/4-inch- (70-mm-) wide, 0.028-inch- (0.7- mm-) thick, galvanized sheet steel or 0.032-inch- (0.8-mm-) thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd. (880 g/sq. m).
2. Tensile Strength: 480 lbf/inch (84 N/mm) in the warp and 360 lbf/inch (63 N/mm) in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F (Minus 40 to plus 93 deg C).

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd. (810 g/sq. m).
2. Tensile Strength: 530 lbf/inch (93 N/mm) in the warp and 440 lbf/inch (77 N/mm) in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F (Minus 45 to plus 121 deg C).

G. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.

1. Minimum Weight: 16 oz./sq. yd. (542 g/sq. m).
2. Tensile Strength: 285 lbf/inch (50 N/mm) in the warp and 185 lbf/inch (32 N/mm) in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F (Minus 55 to plus 260 deg C).

H. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.

1. Minimum Weight: 14 oz./sq. yd. (474 g/sq. m).
2. Tensile Strength: 450 lbf/inch (79 N/mm) in the warp and 340 lbf/inch (60 N/mm) in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F (Minus 55 to plus 260 deg C).

I. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch (6-mm) movement at start and stop.

2.17 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

C. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.

1. Pressure Rating: 4-inch wg (1000 Pa) positive and 0.5-inch wg (125 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 20 to plus 175 deg F (Minus 29 to plus 79 deg C).
4. Insulation R-Value: Comply with ASHRAE/IESNA 90.1.

D. Insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor- barrier film.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 20 to plus 210 deg F (Minus 29 to plus 99 deg C).
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

E. Insulated, Flexible Duct: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20 m/s).
3. Temperature Range: Minus 20 to plus 210 deg F (Minus 29 to plus 99 deg C).
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

F. Insulated, Flexible Duct: UL 181, Class 0, interlocking spiral of aluminum foil; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.

1. Pressure Rating: 8-inch wg (2280 Pa) positive or negative.
2. Maximum Air Velocity: 5000 fpm (25 m/s).
3. Temperature Range: Minus 20 to plus 250 deg F (Minus 29 to plus 121 deg C).
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

G. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action or Nylon strap in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.
2. Non-Clamp Connectors: Adhesive, Liquid adhesive plus tape, or Adhesive plus sheet metal screws.

2.18 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft and control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire dampers according to UL listing.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream or downstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-foot (15-m) spacing.
8. Upstream or downstream from turning vanes.
9. Upstream or downstream from duct silencers.
10. Control devices requiring inspection.
11. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).
3. Head and Hand Access: 18 by 10 inches (460 by 250 mm).
4. Head and Shoulders Access: 21 by 14 inches (530 by 355 mm).
5. Body Access: 25 by 14 inches (635 by 355 mm).
6. Body plus Ladder Access: 25 by 17 inches (635 by 430 mm).

K. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. For fans developing static pressures of 5-inch wg (1250 Pa) and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Connect diffusers or light troffer boots to ducts with maximum 60-inch (1500- mm) lengths of flexible duct clamped or strapped in place.

O. Connect flexible ducts to metal ducts with adhesive, liquid adhesive plus tape, draw bands, or adhesive plus sheet metal screws.

P. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch (6-mm) movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION

SECTION 233423 - HVAC POWER VENTILATORS

PART 1 – GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
1. Provide Payment and Performance Bonds for the full value of their Subcontract.
2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
1. Comply with the Instructions to Bidders.
2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
FILED SUBCONTRACTOR'S BID FOR SECTION:
23 34 23 – HVAC POWER VENTILATORS

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
1. All subcontractors to the Filed Subcontractor, whose work is:
a. Valued at $10,000 or more.
2. The contract sum for each subcontractor required to be listed.
a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
4. Comply with the applicable General Laws and the following:
a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

	Class of Work	Specification section number and name
a.	None.	None.

A. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. M1.00 – Mechanical Notes
2. M1.01 – Mechanical Details
3. M1.02 – Mechanical Specifications
4. M1.03 – Mechanical Zoning Plan
5. M2.00 – Mechanical Floor Plan
6. M2.01 – Mechanical Ventilation/Heating Plan
7. M2.02 – Mechanical Roof Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 23 00 00 – Common Work Results for HVAC
2. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
3. Section 23 05 48 – Vibration and Controls for HVAC Piping and Equipment
4. Section 23 05 53 – Identification for HVAC Piping and Equipment
5. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
6. Section 23 07 13 – Duct Insulation
7. Section 23 08 00 – Commissioning of HVAC
8. Section 23 09 00 – Instrumentation and Controls for HVAC
9. Section 23 31 13 – Metal Ducts
10. Section 23 33 00 – Air Duct Accessories
11. Section 23 34 23 – HVAC Power Ventilators
12. Section 23 37 13 – Diffusers, Registers, and Grilles
13. Section 23 37 23 – HVAC Gravity Ventilators
14. Section 23 34 00 – Particulate Air Filtration
15. Section 23 72 00 – Air-to-Air Energy Recovery Ventilator
16. Section 23 74 16 – Package Rooftop Air Conditioning Units
17. Section 23 82 39 – Unit Heaters

B. Alternates: None.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.4 SUMMARY

A. Section Includes:

1. Centrifugal roof ventilators.
2. Centrifugal wall ventilators.
3. Ceiling-mounted ventilators.
4. In-line centrifugal fans.

1.5 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on actual Project site elevations.

B. Operating Limits: Classify according to AMCA 99.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For unit hangars and supports 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. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
2. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.

1.7 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Roof framing and support members relative to duct penetrations.
2. Ceiling suspension assembly members.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

B. Field quality-control reports.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.9 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set for each belt-driven unit.

1.10 QUALITY ASSURANCE

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.

B. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.11 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aerovent; a division of Twin City Fan Companies, Ltd.
2. Greenheck Fan Corporation.
3. Loren Cook Company.
4. Trane.

B. Housing: Removable, spun-aluminum, dome top and outlet baffle, extruded-aluminum, rectangular top, or galvanized steel, mushroom-domed top; square, one-piece, aluminum base with venturi inlet cone.

1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

D. Belt Drives:

1. Resiliently mounted to housing.
2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
4. Pulleys: Cast-iron, adjustable-pitch motor pulley.
5. Fan and motor isolated from exhaust airstream.

E. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted outside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum or brass wire.
4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
5. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

F. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- (40-mm-) thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch (40-mm) wood nailer. Size as required to suit roof opening and fan base.

1. Configuration: Self-flashing without a cant strip, with mounting flange, Built-in cant and mounting flange, or Built-in raised cant and mounting flange.
2. Overall Height: 12 inches (300 mm).

3. Sound Curb: Curb with sound-absorbing insulation.
4. Pitch Mounting: Manufacture curb for roof slope.
5. Metal Liner: Galvanized steel.
6. Mounting Pedestal: Galvanized steel with removable access panel.
7. Vented Curb: Unlined with louvered vents in vertical sides.

G. Capacities and Characteristics:

1. See schedule on drawings.

2.2 CENTRIFUGAL WALL VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aerovent; a division of Twin City Fan Companies, Ltd.
2. Greenheck Fan Corporation.
3. Loren Cook Company.
4. Trane.

B. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; venturi inlet cone.

C. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.

D. Belt Drives:

1. Resiliently mounted to housing.
2. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
3. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
4. Pulleys: Cast-iron, adjustable-pitch motor pulley.
5. Fan and motor isolated from exhaust airstream.

E. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch (13-mm) mesh, aluminum or brass wire.
4. Wall Grille: Ring type for flush mounting.
5. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in wall sleeve; factory set to close when fan stops.
6. Motorized Dampers: Parallel-blade dampers mounted in curb base with electric actuator; wired to close when fan stops.

F. Capacities and Characteristics:

1. See schedule on drawings.

2.3 CEILING-MOUNTED VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Greenheck Fan Corporation.
   2. Loren Cook Company.

B. Housing: Steel, lined with acoustical insulation.

C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

D. Grille: Louvered grille with flange on intake and thumbscrew attachment to fan housing.

E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

F. Accessories:

   1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
   2. Manual Starter Switch: Single-pole rocker switch assembly with cover and pilot light.
   3. Time-Delay Switch: Assembly with single-pole rocker switch, timer, and cover plate.
   4. Motion Sensor: Motion detector with adjustable shutoff timer.
   5. Ceiling Radiation Damper: Fire-rated assembly with ceramic blanket, stainless-steel springs, and fusible link.
   6. Filter: Washable aluminum to fit between fan and grille.
   7. Isolation: Rubber-in-shear vibration isolators.
   8. Manufacturer's standard roof jack or wall cap, and transition fittings.

G. Capacities and Characteristics:

   1. See schedule on drawings.

2.4 IN-LINE CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Greenheck Fan Corporation.
   2. Loren Cook Company.
   3. Twin City.
   4. Trane.

B. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

C. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

F. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
3. Companion Flanges: For inlet and outlet duct connections.
4. Fan Guards: 1/2- by 1-inch (13- by 25-mm) mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
5. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

G. Capacities and Characteristics:
1. See schedule on drawings.

2.5 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Enclosure Type: Totally enclosed, fan cooled.

2.6 SOURCE QUALITY CONTROL

A. Certify sound-power level ratings according to AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Certify fan performance ratings, including flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests according to AMCA 210, "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating." Label fans with the AMCA-Certified Ratings Seal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Support units using elastomeric mounts or spring isolators having a static deflection of 1 inch (25 mm). Vibration- control devices are specified in Section 230548 "Vibration Controls for HVAC Piping and Equipment."

1. Secure vibration controls to concrete bases using anchor bolts cast in concrete base.

C. Secure roof-mounted fans to roof curbs with cadmium-plated hardware. See Section 077200 "Roof Accessories" for installation of roof curbs.

D. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

E. Support suspended units from structure using threaded steel rods and elastomeric hangers or spring hangers having a static deflection of 1 inch (25 mm). Vibration-control devices are specified in Section 230548 "Vibration Controls for HVAC Piping and Equipment."

F. Install units with clearances for service and maintenance.

G. Label units according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 – GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
1. Provide Payment and Performance Bonds for the full value of their Subcontract.
2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
1. Comply with the Instructions to Bidders.
2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
FILED SUBCONTRACTOR'S BID FOR SECTION:
23 37 13 – DIFFUSERS, REGISTERS, AND GRILLES

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
1. All subcontractors to the Filed Subcontractor, whose work is:
   a. Valued at $10,000 or more.
2. The contract sum for each subcontractor required to be listed.
   a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
4. Comply with the applicable General Laws and the following:
   a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

	Class of Work	Specification section number and name
a.	None.	None.

A. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. M1.00 – Mechanical Notes
2. M1.01 – Mechanical Details
3. M1.02 – Mechanical Specifications
4. M1.03 – Mechanical Zoning Plan
5. M2.00 – Mechanical Floor Plan
6. M2.01 – Mechanical Ventilation/Heating Plan
7. M2.02 – Mechanical Roof Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 23 00 00 – Common Work Results for HVAC
2. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
3. Section 23 05 48 – Vibration and Controls for HVAC Piping and Equipment
4. Section 23 05 53 – Identification for HVAC Piping and Equipment
5. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
6. Section 23 07 13 – Duct Insulation
7. Section 23 08 00 – Commissioning of HVAC
8. Section 23 09 00 – Instrumentation and Controls for HVAC
9. Section 23 31 13 – Metal Ducts
10. Section 23 33 00 – Air Duct Accessories
11. Section 23 34 23 – HVAC Power Ventilators
12. Section 23 37 13 – Diffusers, Registers, and Grilles
13. Section 23 37 23 – HVAC Gravity Ventilators
14. Section 23 34 00 – Particulate Air Filtration
15. Section 23 72 00 – Air-to-Air Energy Recovery Ventilator
16. Section 23 74 16 – Package Rooftop Air Conditioning Units
17. Section 23 82 39 – Unit Heaters

B. Alternates: None.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.4 SUMMARY

A. Section Includes:

1. Round ceiling diffusers.
2. Rectangular and square ceiling diffusers.
3. Louver face diffusers.
4. Adjustable bar register
5. Adjustable bar grilles
6. Fixed face registers and grilles.

B. Related Sections:

1. Section 08 90 00 "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
2. Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Round Ceiling Diffuser :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Tuttle & Bailey
    b. Anemostat Products; a Mestek company.
    c. Price Industries.
    d. Titus.

2. Devices shall be specifically designed for variable-air-volume flows.
3. See schedule on drawings for capacities, characteristics, and accessories.

B. Rectangular and Square Ceiling Diffusers :

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Tuttle & Bailey
    b. Anemostat Products; a Mestek company.
    c. Price Industries.
    d. Titus.

2. Devices shall be specifically designed for variable-air-volume flows.
3. See schedule on drawings for capacities, characteristics, and accessories.

C. Louver Face Diffuser:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Tuttle & Bailey
    b. Anemostat Products; a Mestek company.
    c. Price Industries.
    d. Titus.

2. Devices shall be specifically designed for variable-air-volume flows.
3. See schedule on drawings for capacities, characteristics, and accessories.

2.2 REGISTERS AND GRILLES

A. Adjustable Bar Register:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Tuttle & Bailey
    b. Anemostat Products; a Mestek company.
    c. Price Industries.
    d. Titus.
3. Finish: Baked enamel, white.
4. See schedule on drawings for capacities, characteristics, and accessories.

B. Adjustable Bar Grille:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Tuttle & Bailey
    b. Anemostat Products; a Mestek company.
    c. Price Industries.
    d. Titus.

2. Material: Aluminum.
3. Finish: Baked enamel, white.
4. See schedule on drawings for capacities, characteristics, and accessories.

C. Fixed Face Register:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Tuttle & Bailey
    b. Anemostat Products; a Mestek company.
    c. Price Industries.
    d. Titus.
2. Material: Aluminum
3. Finish: Baked enamel, white.
4. See schedule on drawings for capacities, characteristics, and accessories.

D. Fixed Face Grille:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Tuttle & Bailey
    b. Anemostat Products; a Mestek company.
    c. Price Industries.
    d. Titus.

2. Material: Aluminum.
3. Finish: Baked enamel, white.
4. See schedule on drawings for capacities, characteristics, and accessories.

2.3 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 233723 - HVAC GRAVITY VENTILATORS

PART 1 – GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
1. Provide Payment and Performance Bonds for the full value of their Subcontract.
2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
1. Comply with the Instructions to Bidders.
2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
FILED SUBCONTRACTOR'S BID FOR SECTION:
23 37 23 – HVAC GRAVITY VENTILATORS

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
1. All subcontractors to the Filed Subcontractor, whose work is:
a. Valued at $10,000 or more.
2. The contract sum for each subcontractor required to be listed.
a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
4. Comply with the applicable General Laws and the following:
a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

	Class of Work	Specification section number and name
a.	None.	None.

A. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. M1.00 – Mechanical Notes
2. M1.01 – Mechanical Details
3. M1.02 – Mechanical Specifications
4. M1.03 – Mechanical Zoning Plan
5. M2.00 – Mechanical Floor Plan
6. M2.01 – Mechanical Ventilation/Heating Plan
7. M2.02 – Mechanical Roof Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 23 00 00 – Common Work Results for HVAC
2. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
3. Section 23 05 48 – Vibration and Controls for HVAC Piping and Equipment
4. Section 23 05 53 – Identification for HVAC Piping and Equipment
5. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
6. Section 23 07 13 – Duct Insulation
7. Section 23 08 00 – Commissioning of HVAC
8. Section 23 09 00 – Instrumentation and Controls for HVAC
9. Section 23 31 13 – Metal Ducts
10. Section 23 33 00 – Air Duct Accessories
11. Section 23 34 23 – HVAC Power Ventilators
12. Section 23 37 13 – Diffusers, Registers, and Grilles
13. Section 23 37 23 – HVAC Gravity Ventilators
14. Section 23 34 00 – Particulate Air Filtration
15. Section 23 72 00 – Air-to-Air Energy Recovery Ventilator
16. Section 23 74 16 – Package Rooftop Air Conditioning Units
17. Section 23 82 39 – Unit Heaters

B. Alternates: None.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.4 SUMMARY

A. Section Includes:

1. Louvered-penthouse ventilators.
2. Roof hoods.
3. Goosenecks.

1.5 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design ventilators, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.

B. Structural Performance: Ventilators shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of ventilator components, noise or metal fatigue caused by ventilator blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal 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. (960 Pa), acting inward or outward.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

D. Water Entrainment: Limit water penetration through unit to comply with ASHRAE 62.1.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For gravity ventilators. Include plans, elevations, sections, details, ventilator attachments to curbs, and curb attachments to roof structure.

1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.

C. Samples: For each exposed product and for each color and texture specified.

D. Samples for Initial Selection: For units with factory-applied color finishes.

E. Samples for Verification: For each type of louvered-penthouse ventilator indicated, in manufacturer's standard size.

F. Delegated-Design Submittal: For shop-fabricated ventilators 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. Detail fabrication and assembly of shop-fabricated ventilators.

1.7 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof framing plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members to which roof curbs and ventilators will be attached.
2. Sizes and locations of roof openings.

B. Welding certificates.

1.8 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, "Structural Welding Code - Sheet Steel."

1.9 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T5 or T-52.

B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.

C. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 (Z275) zinc coating, mill phosphatized.

D. Stainless-Steel Sheet: ASTM A 666, Type 304, with No. 6 finish.

E. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel unless otherwise indicated. Do not use metals that are incompatible with joined materials.

1. Use types and sizes to suit unit installation conditions.
2. Use Phillips hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.

F. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors made from stainless-steel components, with capability to sustain without failure a load equal to 4 times the loads imposed for concrete, or 6 times the load imposed for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

A. Factory or shop fabricate gravity ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.

D. Fabricate supports, anchorages, and accessories required for complete assembly.

E. Perform shop welding by AWS-certified procedures and personnel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install gravity ventilators level, plumb, and at indicated alignment with adjacent work.

B. Install gravity ventilators with clearances for service and maintenance.

C. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

D. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Section 079200 "Joint Sealants" for sealants applied during installation.

E. Label gravity ventilators according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

F. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

G. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence

remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in Section 233113 "Metal Ducts" and Section 233116 "Nonmetal Ducts." Drawings indicate general arrangement of ducts and duct accessories.

3.3 ADJUSTING

A. Adjust damper linkages for proper damper operation.

END OF SECTION

SECTION 234100 – PARTICULATE AIR FILTRATION

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
1. Provide Payment and Performance Bonds for the full value of their Subcontract.
2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
1. Comply with the Instructions to Bidders.
2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
FILED SUBCONTRACTOR'S BID FOR SECTION:
23 41 00 – PARTICULATE AIR FILTRATION

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
1. All subcontractors to the Filed Subcontractor, whose work is:
a. Valued at $10,000 or more.
2. The contract sum for each subcontractor required to be listed.
a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
4. Comply with the applicable General Laws and the following:
a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

	Class of Work	Specification section number and name
a.	None.	None.

A. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. M1.00 – Mechanical Notes
2. M1.01 – Mechanical Details
3. M1.02 – Mechanical Specifications
4. M1.03 – Mechanical Zoning Plan
5. M2.00 – Mechanical Floor Plan
6. M2.01 – Mechanical Ventilation/Heating Plan
7. M2.02 – Mechanical Roof Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 23 00 00 – Common Work Results for HVAC
2. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
3. Section 23 05 48 – Vibration and Controls for HVAC Piping and Equipment
4. Section 23 05 53 – Identification for HVAC Piping and Equipment
5. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
6. Section 23 07 13 – Duct Insulation
7. Section 23 08 00 – Commissioning of HVAC
8. Section 23 09 00 – Instrumentation and Controls for HVAC
9. Section 23 31 13 – Metal Ducts
10. Section 23 33 00 – Air Duct Accessories
11. Section 23 34 23 – HVAC Power Ventilators
12. Section 23 37 13 – Diffusers, Registers, and Grilles
13. Section 23 37 23 – HVAC Gravity Ventilators
14. Section 23 34 00 – Particulate Air Filtration
15. Section 23 72 00 – Air-to-Air Energy Recovery Ventilator
16. Section 23 74 16 – Package Rooftop Air Conditioning Units
17. Section 23 82 39 – Unit Heaters

B. Alternates: None.

1.3 DESCRIPTION

A. Air filters for heating, ventilating and air conditioning.

B. Definitions: Refer to ASHRAE 52.1-92 for definitions of face velocity, net effective filtering area, media velocity, resistance (pressure drop), atmospheric dust spot efficiency and dust-holding capacity.

1.4 RELATED WORK

A. Section 15050, BASIC METHODS AND REQUIREMENTS (MECHANICAL).

B. Section 15770, UNITARY AIR CONDITIONING EQUIPMENT.

1.5 QUALITY ASSURANCE

A. Air Filter Performance Report For Extended Surface Filters:
   1. Submit a test report for each Grade of filter being offered. The report shall be less than five years old and will have been prepared by an independent testing laboratory using test equipment, method and duct section as specified by ASHRAE Standard 52.1-92 for type filter under test and acceptable to Resident Engineer, indicating that filters comply with the requirements of this specification. Test for 150 m/min (500 fpm) will be accepted for lower velocity rated filters provided the test report of an independent testing laboratory complies with all the requirements of this specification.
   2. Selection procedures: All filters tested shall have been procured by the independent testing laboratory from the open market independent of manufacturer of these filters and a statement to this effect must accompany test report.

B. Filter Supplier Warranty for Extended Surface Filters: Guarantee the filters against leak, blow-outs, and other deficiencies during their normal useful life. Defective filters shall be replaced at no cost to the Government.

C. Nameplates: Each filter shall bear a label or name plate indicating manufacturer's name, filter size, rated efficiency, UL.classification, and file number.

1.6 SUBMITTALS

A. Submit in accordance with Section 01340, SAMPLES AND SHOP DRAWINGS.

B. Manufacturer's Literature and Data:
   1. Extended surface filters.
   2. Holding frames. Identify locations.
   3. Side access housings. Identify locations, verify insulated doors.

C. Air filter performance reports.

D. Suppliers warranty.

1.7 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.

B. American Society of Heating, Refrigerating and Air-conditioning Engineers, Inc. (ASHRAE):

52.1-92 ..... Methods of Testing Air Cleaning Devices Used in General Ventilation For Removing Particulate Matter

C. Underwriters Laboratories, Inc. (UL):

586-90 ..... UL Standard for Safety High-Efficiency, Particulate, Air Filter Units

900-87 ..... UL Standard for Safety Test Performance of Air Filter Units

D. Federal Specification (Fed. Spec.):

A-A-l4l9D ..... Filter, Element Air Conditioning (Viscous-Impingement and Dry Type, Replaceable).

PART 2 - PRODUCTS

2.1 REPLACEMENT FILTER ELEMENTS TO BE FURNISHED

A. To allow temporary use of HVAC systems for testing and in accordance with Paragraph, TEMPORARY USE OF MECHANICAL AND ELECTRICAL SYSTEMS in Section 01010, GENERAL REQUIREMENTS, provide one complete set of additional (replacement) filter elements.

B. The Architect/Engineer will direct whether these additional filters will either be installed as replacements for dirty units or turned over to owner for future use as replacements.

2.2 EXTENDED SURFACE AIR FILTERS

A. Use factory assembled air filters of the extended surface type with supported or non-supported cartridges for removal of particulate matter in air conditioning, heating and ventilating systems. Filter units shall be of the extended surface type fabricated for disposal when the dust-load limit is reached as indicated by maximum (final) pressure drop.

B. Filter Classification: UL approved Class 1 or Class 2 conforming to UL Standard 900.

C. Filter Grades, Percent, Nominal Efficiency and Application:

1. Grade A: 90-95 after-filter.
2. Grade B: 80-85 after-filter.
3. Grade C: 50-60 pre-filter.
4. Grade D: 25-30 pre-filter.

E. Filter Efficiency and Arrestance: Efficiency and arrestance of filters shall be determined in accordance with ASHRAE 52.1-92. Atmospheric dust spot efficiency and synthetic dust weight arrestance shall not be less than the following:

	Percentage of Initial Efficiency	Percentage of Average Efficiency	Percentage of Average Arrestance
Grade A	75.4	86.4	99.0
Grade B	58.0	79.0	98.0
Grade C	25.0	53.0	97.0
Grade D	Less than 20.0	22.0	89.0

F. Maximum initial and final resistance, Pa (inches of water), for each filter cartridge when operated at 150 m/min (500 feet per minute) face velocity:

	Initial Resistance	Final Resistance
Grade A (Bag)	130 (0.52)	250 (1.00)
Grade A (Rigid Pleated)	185 (0.74)	250 (l.00)
Grade B (Bag)	100 (0.40)	250 (l.00)
Grade B (Rigid Pleated)	150 (0.60)	250 (l.00)
Grade C (Bag)	70 (0.28)	200 (0.80)
Grade C (Rigid Pleated)	85 (0.35)	200 (0.80)
Grade D (2-inch deep)	80 (0.32)	175 (0.70)
Grade D (4-inch deep)	65 (0.27)	175 (0.70)

G. Dust Holding Capacity: When tested to 250 Pa (l.00-inch water) at 150 m/min (500 fpm) face velocity, the dust holding capacity for each 600 mm by 600 mm (24 inches by 24 inches) (face area) filter shall be at least the values listed below. For other filter sizes the dust holding capacity shall be proportionally higher or lower to the face area.

Grade A (Bag)	300 grams
Grade A (Rigid Pleated)	90 grams
Grade B (Bag)	430 grams
Grade B (Rigid Pleated)	175 grams

Grade C (Bag)	910 grams
Grade C (Rigid Pleated)	250 grams
Grade D (2 inch deep)	150 grams
Grade D (4 inch deep)	300 grams

H. Minimum Media Area: The minimum net effective media area in square meter (square feet) for each 600 mm by 600 mm (24 inches by 24 inches) (face area) filter at 150 m/min (500 fpm) face velocity shall be at least the values listed below. For other filter sizes the net effective media area shall be proportionally higher or lower.

Grade A (Bag)	8.5 (9l.0)
Grade A (Rigid Pleated)	5.3 (57.0)
Grade B (Bag)	8.5 (9l.0)
Grade B (Rigid Pleated)	5.3 (57.0)
Grade C (Bag)	8.5 (9l.0)
Grade C (Rigid Pleated)	5.3 (57.0)
Grade D (2-inch deep)	1.4 (l4.8)
Grade D (4-inch deep)	2.1 (23.0)

I. Side Servicing Housings:

1. Minimum 1.6 mm (l6 gage galvanized steel, or aluminum, completely factory assembled with upstream and downstream flanges for connection into the duct system. Furnish housing length sufficient to provide for fully extended operating filter elements.

2. Access doors: Double skin insulated, at each end of the housing with continuous gasketing on the perimeter and positive locking devices. Design doors to withstand a minimum positive/negative 1.0 kPa (four inches of water) static pressure.
3. Filter slide channels: Channels shall incorporate a positive-sealing gasket material to seal the top and bottom of the filter cartridge frames to prevent bypass. Provide factory installed gasketing to prevent leakage between cartridges, and between cartridges and doors.

J. Holding Frame System:
   1. Minimum 1.6 mm (l6 gage) galvanized steel, 100 mm (4 inches) deep, factory complete with hardware necessary for field assembly, suitable for either upstream or downstream filter servicing. All members shall be cut to size and prepunched for easy assembly into modules of the size and capacity noted in the schedules.
   2. The framing members shall be permanently gasketed to prevent the bypass of unfiltered air. If required, furnish suitable vertical support members to prevent deflection of horizontal members. The vertical support members shall not interfere with either the installation or operation of the filters.
   3. The framing system shall incorporate a factory installed positive sealing device for each row of filters. This device shall allow for easy installation and removal of cartridges and shall insure the seal between the gasketed filter elements while the bank is in operation.

K. Magnehelic Differential Pressure Filter Gages, if specified: Nominal 100 mm (four inch) diameter, zero to 500 Pa (zero to two inch water gage) range, flush mounted in aluminum panel board, complete with static tips, copper or aluminum tubing, and accessory items to provide zero adjustment. Provide one gage for each extended surface filter section. Provide Petcocks for each gauge.

L. Equipment Identification: Section 15050, BASIC METHODS AND REQUIREMENTS (MECHANICAL).

2.3 HEPA FILTERS IF SPECIFIED

A. High Efficiency Particulate Air (HEPA) filters shall be individually tested and certified to be 99.97 percent minimum efficient when handling 0.3 micron particles in accordance with DOP test method. Filters shall be factory scanned. The DOP efficiency along with filter serial number and name of manufacturer shall be marked on the filter. HEPA filter shall have maximum pressure drop of 250 Pa (1” WG) when clean at rated flow with a final pressure drop of 500 Pa (2” WG).

B. Filter media: Factory constructed by pleating a continuous sheet of media into closely spaced pleats with kraft or aluminum separators. Sealer shall be self-extinguishing.

C. Enclosing frame shall be 16 gauge galvanized steel. Provide pre-filters in the same housing with a separate removal assembly that operates independently from the HEPA filters.

D. Pre-filter: Type D, 2 inches deep. See paragraph 2.2

E. Bag-In/Bag-Out Housing for HEPA Filters:
   1. Housing shall be fabricated of 15 gauge type 304 stainless steel.

2. Housing shall be equipped with weather covers, drilled face flanges and factory mounted Magnehelic gauges with Petcocks housed in stainless steel brackets.
3. Housing shall be pressure tested in factory for high quality to withstand a positive or negative pressure of 10" WG. If HEPA filters are specified for TB Isolation Rooms, perform a quantitative leakage and filter performance DOP (Dioctyl Phthalate Penetration) field test in addition to factory test at the initial installation recommended by the Center for Disease Control (CDC).
4. Housing shall incorporate a spring loaded clamping mechanism that is operated from outside and which is capable of exerting a 5340 N (1,200 lb.) sealing force across the top and bottom of each filter.
5. Each housing shall have a bagging ring around the access port that is sealed by a removable, gasketed access door. The bagging ring shall have two (2) continuous ribs to secure the plastic change-out bag and be hemmed on its outer edge to prevent the bag from tearing.
6. One 87 mil thick PVC change-out bag shall be supplied for each access door. The bag shall include approximately 300 mm (12 inches) of transparent PVC at the open end and three glove sleeves built into the body to assist in filter change-out. Bag-In/Bag-Out housings shall be manufactured under a quality assurance program that addresses the requirements of ANSI N45.2, "Quality Assurance Requirements for Nuclear Power Plants."

2.4 ELECTRONIC AIR FILTERS

1. Provide and install manufacturer's electronic air filter as specified on the drawings or approved equal.
2. Electronic air filter shall be UL and/or cUL listed.
3. Installation shall comply with manufacturer's installation instructions and code.

2.5 UVC GERMICIDAL AIR PURIFIERS

1. Provide and install manufacturer's high intensity quartz UVC germicidal lamp air purifier, as specified on the drawings or approved equal.
2. Germicidal air purifier shall be CSA and/or NRTL/C certified.
3. Installation shall comply with manufacturer's installation instructions and code.

PART 3 - EXECUTION

3.1 INSTALLATION

Install supports, filters and gages in accordance with manufacturer's instructions.

3.2 START-UP AND TEMPORARY USE

A. Clean and vacuum air handling units and plenums to the satisfaction of the Architect/Engineer prior to starting air handling systems.

B. Install or deliver replacement filter units as directed by the Architect/Engineer.

END OF SECTION

SECTION 237200 - AIR-TO-AIR ENERGY RECOVERY VENTILATOR

PART 1 – GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
1. Provide Payment and Performance Bonds for the full value of their Subcontract.
2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
1. Comply with the Instructions to Bidders.
2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
FILED SUBCONTRACTOR'S BID FOR SECTION:
23 72 00 – AIR-TO-AIR ENERGY RECOVERY VENTILATOR

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
1. All subcontractors to the Filed Subcontractor, whose work is:
   a. Valued at $10,000 or more.
2. The contract sum for each subcontractor required to be listed.
   a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
4. Comply with the applicable General Laws and the following:
   a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

	Class of Work	Specification section number and name
a.	None.	None.

A. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. M1.00 – Mechanical Notes
2. M1.01 – Mechanical Details
3. M1.02 – Mechanical Specifications
4. M1.03 – Mechanical Zoning Plan
5. M2.00 – Mechanical Floor Plan
6. M2.01 – Mechanical Ventilation/Heating Plan
7. M2.02 – Mechanical Roof Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 23 00 00 – Common Work Results for HVAC
2. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
3. Section 23 05 48 – Vibration and Controls for HVAC Piping and Equipment
4. Section 23 05 53 – Identification for HVAC Piping and Equipment
5. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
6. Section 23 07 13 – Duct Insulation
7. Section 23 08 00 – Commissioning of HVAC
8. Section 23 09 00 – Instrumentation and Controls for HVAC
9. Section 23 31 13 – Metal Ducts
10. Section 23 33 00 – Air Duct Accessories
11. Section 23 34 23 – HVAC Power Ventilators
12. Section 23 37 13 – Diffusers, Registers, and Grilles
13. Section 23 37 23 – HVAC Gravity Ventilators
14. Section 23 34 00 – Particulate Air Filtration
15. Section 23 72 00 – Air-to-Air Energy Recovery Ventilator
16. Section 23 74 16 – Package Rooftop Air Conditioning Units
17. Section 23 82 39 – Unit Heaters

B. Alternates: None.

1.3 SUMMARY

A. This section includes Air-to-Air Energy Recovery Ventilators for outdoor installation.

B. The Energy Recovery Ventilator shall be a packaged unit and shall transfer both sensible and latent energy using rotary air-to-air heat exchanger technology.

C. Within this document, these units may be referred to as Energy Recovery Ventilator (ERV) for brevity.

1.4 RELATED

A. Drawing and general provisions of the contract, including General Requirements Division 01, Division 23, Division 23 Specifications Sections, and common work requirements for HVAC apply to work specified in this section.
B. Section 23 09 00: Controls and Instrumentation

1.5 SUBMITTALS

A. Product data: For each type or model of Energy Recovery Ventilator, include the following:
    1. HVI Certified Performance Data for both Supply Air and Exhaust Air with net airflow at varying external static pressures.
    2. Dimensioned drawings showing front, side and plan views, to include location of attached service clearance requirements.
    3. Estimated gross weight of each installed unit.
    4. Filter types, quantities, and sizes
    a. Installation, Operating and Maintenance manual (IOM) for each model.
B. Shop Drawings: For air-to-air energy recovery ventilators, include plans, elevations, sections, details, and attachments to other work.
    1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
C. Operation and maintenance data for air-to-air energy recovery ventilator

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain Air-to-Air Energy Recovery Ventilator with all appurtenant components or accessories from a single manufacturer. ERV manufacturer shall have a minimum of 20 years experience manufacturing ERVs.
B. For the actual fabrication, installation, and testing of work under this section, use only thoroughly trained and experienced workers completely familiar with the items required and with the manufacturer's current recommended methods of installation.
C. The ERV core shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of ten (10) years from the date of purchase. The balance-of-unit shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of five (5) years from the date of purchase.
D. Manufacturer shall be able to provide evidence of independent testing of the core by Underwriters Laboratory (UL), verifying a maximum flame spread index (FSI) of 25 and a maximum smoke developed index (SDI) of 50 thereby meeting NFPA90A and NFPA 90B requirements for materials in a compartment handling air intended for circulation through a duct system. The method of test shall be UL Standard 723.
E. Certifications:

    1. The energy recovery ventilator shall be certified by the Home Ventilating Institute (HVI) under CSA 439. Both a heating and a cooling test must be run to demonstrate year-round energy recovery.

2. Unit shall be listed under UL 1812 Standard for Ducted Air to Air Heat Exchangers. The unit must pass commercial flammability requirements and shall not be labeled “For Residential Use Only”

1.7 COORDINATION

A. Coordinate size and location of all building penetrations required for installation of each Energy Recovery Ventilator and associated electrical systems.
B. Coordinate sequencing of construction for associated plumbing, HVAC, electrical supply.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with specifications contained within this document, manufacturers offering products that may be incorporated into the work include, but are not limited to:

1. Carrier

2.2 MANUFACTURED UNITS

A. Energy Recovery Cassette

1. The energy recovery media shall have a minimum of 70% effectiveness at nominal unit airflow.
2. Energy wheel performance shall be ARI Standard 1060 Certified and bear the ARI Certified Product Seal.
3. The energy recovery cassette shall be an UL Recognized component for electrical and fire safety.
4. The wheel shall be coated with silica gel desiccant, permanently bonded without the use of binders or adhesives.
5. Coated wheels shall be washable with detergent or alkaline coil cleaner and water.
6. The silica gel shall not dissolve or deliquesce in the presence of water or high humidity.
7. The substrate shall be made of a lightweight polymer and shall not degrade or require additional coatings for application in coastal environments.
8. The wheel polymer layers shall be wound continuously with one flat and one structured layer in an ideal parallel plate geometry providing laminar flow and minimum pressure drop.
9. The polymer layers shall be captured in a stainless steel wheel frame or aluminum and stainless steel segment frames that provide a rigid and self-supporting matrix.
10. Energy recovery wheels greater than 19 inches in diameter shall be provided with removable wheel segments.
11. Wheel frame shall be a welded hub, spoke and rim assembly of stainless, plated, and or coated steel and shall be self supporting without the wheel segments in place.
12. Wheel segments shall be removable without the use of tools to facilitate maintenance and cleaning.

13. Wheel rim shall be continuous rolled stainless steel and the wheel shall be connected to the shaft by means of taper locks.
14. Wheel bearings shall provide an L-10 life of 400,000 hours.
15. Drive belts of stretch urethane shall be provided for wheel rim drive without the need for external tensioners or adjustment.

B. Special Features (Options and Accessories)

1. Supply and exhaust air frost control option

    a. Factory-installed frost protection module shall sense pressure differential across the energy recovery cassette.
    b. Supply blower shall be shut-off if the pressure differential across the energy recovery cassette exceeds an adjustable set point. Blower shall remain off for an adjustable time period.
    c. Exhaust blower and wheel shall remain in operation in order to remove any frost build-up on the wheel.

1. EnergyX maintenance indicator package

    a. A factory-installed switch shall monitor EnergyX blowers and wheel motor amp draw and send a signal to fieldsupplied 24-v indicator upon amperage surge that maintenance required.

1. Filter maintenance indicator

    a. A factory-installed differential pressure switch shall measure pressure drop across the outside air filter and activate a field-supplied 24-v indicator when airflow is restricted. It shall not interrupt EnergyX operation. Switch set point shall be adjustable.

1. EnergyX free cooling with enthalpy and stop/jog control

    a. An enthalpy sensor shall prevent the wheel from rotating if the outside air conditions are acceptable for free cooling. Both exhaust and supply blowers will remain on.
    b. Stop-Jog-Control shall energize the wheel periodically during the free cooling operation of the EnergyX to prevent dirt build-up on the wheel.

2. Economizer Option

    a. The economizer shall be integrated in the energy recovery module and shall allow air to bypass the energy recovery wheel for free cooling and fail safe operation. Tilting wheel mechanisms shall not be allowed.

b. The economizer damper shall be motorized with factory installed, 24-volt Belimo actuator.
c. The EnergyX shall be capable of using the economizer in a free cooling operation.
d. The economizer shall utilize enthalpy sensor controls when in the economizer mode.

3. CO2 Sensor

a. The modulating airflow energy recovery unit shall be capable of incorporating a CO2 sensor for use with Demand Control Ventilation.
b. The CO2 sensor shall connect to the base rooftop unit's digital controller.
c. The modulating airflow energy recovery unit shall use at a minimum, a high & low CFM airflow set point when a CO2 sensor is used.

4. Roof Curb Extension (PM16-28 sizes with EnergyX) Accessory for use with EnergyX units

a. The energy recovery module shall us the standard rooftop unit rooftop curb.
b. Rooftop extensions, support rails or other devices that come in contact with the roof surface to support the energy recovery module shall not be allowed.
c. A horizontal adapter curb shall be used to convert vertical return air applications into horizontal return air applications. The supply airflow shall be convertible via the base rooftop unit operation and restrictions.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Prior to start of installation, examine area and conditions to verify correct location for compliance with installation tolerances and other conditions affecting unit performance. See unit IOM.
B. Examine roughing-in of plumbing, electrical and HVAC services to verify actual location and compliance with unit requirements. See unit IOM.
C. Proceed with installation only after all unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Installation shall be accomplished in accordance with these written specifications, project drawings, manufacturer's installation instructions as documented in manufacturer's IOM, Best Practices and all applicable building codes.
B. Install unit with clearances for service and maintenance.
C. Locate, orient, and connect ductwork per AMCA, ASHRAE, and SMACNA guidelines. Provide service clearances as indicated on the plans. Locate units distant from sound critical occupancies.

3.3 FIELD QUALITY CONTROL

A. Contractor to inspect field assembled components and equipment installation, to include electrical and piping connections. Report results to Architect/Engineer in writing. Inspection must include a complete startup checklist to include (as a minimum) the following: Completed Start-Up Checklists as found in manufacturer's IOM. Insert any other requirements here.

3.4 START-UP SERVICE

A. Contractor to perform startup service. Refer to Division 23 "Testing, Adjusting and Balancing" and comply with provisions therein. Refer to the manufacturer's installation, operation and maintenance IOM manual for startup procedure.
B. Test and Balancing may not begin until 100% of the installation is complete and fully functional.
C. Follow National Environmental Balancing Bureau (NEBB) air test and balance procedures specific to energy recovery devices. Provide balancing reports to owner's representatives.

3.6 DEMONSTRATION AND TRAINING

A. Contractor to train owners or owner's maintenance personnel to adjust, operate and maintain the ERV. Refer to Division 01 Section Closeout Procedures and Demonstration and Training.

END OF SECTION

SECTION 237416 – PACKAGE ROOFTOP AIR CONDITIONING UNITS

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
1. Provide Payment and Performance Bonds for the full value of their Subcontract.
2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
1. Comply with the Instructions to Bidders.
2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
FILED SUBCONTRACTOR'S BID FOR SECTION:
23 74 16 – PACKAGE ROOFTOP AIR CONDITIONING UNITS

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
1. All subcontractors to the Filed Subcontractor, whose work is:
a. Valued at $10,000 or more.
2. The contract sum for each subcontractor required to be listed.
a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
4. Comply with the applicable General Laws and the following:
a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

	Class of Work	Specification section number and name
a.	None.	None.

A. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. M1.00 – Mechanical Notes
2. M1.01 – Mechanical Details
3. M1.02 – Mechanical Specifications
4. M1.03 – Mechanical Zoning Plan
5. M2.00 – Mechanical Floor Plan
6. M2.01 – Mechanical Ventilation/Heating Plan
7. M2.02 – Mechanical Roof Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 23 00 00 – Common Work Results for HVAC
2. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
3. Section 23 05 48 – Vibration and Controls for HVAC Piping and Equipment
4. Section 23 05 53 – Identification for HVAC Piping and Equipment
5. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
6. Section 23 07 13 – Duct Insulation
7. Section 23 08 00 – Commissioning of HVAC
8. Section 23 09 00 – Instrumentation and Controls for HVAC
9. Section 23 31 13 – Metal Ducts
10. Section 23 33 00 – Air Duct Accessories
11. Section 23 34 23 – HVAC Power Ventilators
12. Section 23 37 13 – Diffusers, Registers, and Grilles
13. Section 23 37 23 – HVAC Gravity Ventilators
14. Section 23 34 00 – Particulate Air Filtration
15. Section 23 72 00 – Air-to-Air Energy Recovery Ventilator
16. Section 23 74 16 – Package Rooftop Air Conditioning Units
17. Section 23 82 39 – Unit Heaters

B. Alternates: None.

1.3 DESCRIPTION

A. This section specifies rooftop units.

B. Definitions:

1. Energy Efficiency Ratio (EER): A ratio calculated by dividing the cooling capacity in Watts (Btuh) by the power input in watts at any given set of rating conditions, expressed in Watts (Btuh) per watt.

2. Unitary (ARI): Consists of one or more factory-made assemblies which normally include an evaporator or

cooling coil, a compressor and condenser combination, and may include a heating function.

1.4 RELATED WORK

A. Section 15050: BASIC METHODS AND REQUIREMENTS (MECHANICAL).

B. Section 15880: AIR FILTERS.

C. Section 15980: TESTING, ADJUSTING AND BALANCING.

1.5 QUALITY ASSURANCE

A. Refer to Section, BASIC METHODS AND REQUIREMENTS (MECHANICAL).

B. Safety Standards: ASHRAE Standard 15, design, manufacture and installation of mechanical refrigeration equipment.

1.6 SUBMITTALS

A. Submit in accordance with Section 01340, SAMPLES AND SHOP DRAWINGS.

B. Manufacturer's Literature and Data:

1. Unitary air conditioners:

a. Rooftop units.

C. Submit proof of specified ARI Certification.

D. Performance Rating: Submit catalog selection data showing equipment ratings and compliance with required sensible-to-heat-ratio, energy efficiency ratio (EER), and coefficient of performance(COP).

1.7 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. Air-Conditioning and Refrigeration Institute (ARI) Standards:

210/240-89..... Unitary Air-conditioning and Air Source Heat Pump Equipment

270-84.....Sound Rating of Outdoor Unitary Equipment

360-86.....Commercial and Industrial Unitary Air-Conditioning Equipment

520-90..... Positive Displacement Refrigerant Compressors, Compressor Units and Condensing Units

ARI-DCAACP..... Directory of Applied Air Conditioning Products

E. Air Movement and Control Association(AMCA):

210-85..... Laboratory Methods of Testing Fans for Rating

410-90..... Recommended Safety Practices for Air Moving Devices

F. American National Standards Institute(ANSI):

S12.31-90..... Precision Methods for the Determination of Sound Power Levels of Broad-Band Noise Sources in Reverberation Rooms

G. American Society of Heating, Refrigerating, and Air-Conditioning Engineers Inc. (ASHRAE), Inc. Publications:

1988 Equipment Handbook

1987 Systems Handbook

H. American Society of Testing and Materials (ASTM):

B117-90..... Standard Method of Salt Spray(Fog) Testing

I. National Electrical Manufacturer's Association(NEMA):

MG-1-93..... Motors and Generators

ICS-1-R90..... Industrial Controls and Systems

J. National Fire Protection Association (NFPA) Publications:

90A-1996..... Standard for the Installation of Air-conditioning and Ventilating Systems

PART 2 - PRODUCTS

2.1 UNITARY AIR CONDITIONERS

A. Applicable ARI Standards:

1. Capacity 39.6 kW (135,000 Btu/h) and greater: ARI 360.
2. Capacity Below 39.6 kW (135,000 Btu/h): ARI 210. Units shall be listed in the ARI Directory of Certified Unitary Air-Conditioners.

B. Performance Rating: Cooling capacity of unit shall meet the sensible heat requirements and total heat requirements shown in the contract documents. In selecting unit size, make true allowance for "sensible to total heat ratio" to satisfy required sensible cooling capacity.

C. Machinery Guards: Provide guards as shown in AMCA 410 for belts, chains, couplings, pulleys, sheaves, shafts, gears and other moving parts regardless of height above the floor. Drive guards may be excluded where motors and drives are inside factory fabricated casings.

D. Corrosion Prevention: Unless specified otherwise, equipment fabricated from ferrous metals that do not have a zinc coating or a duplex coating of zinc and paint shall be treated for prevention of rust with a factory coating or paint system that will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall be tested for 500 hours. the salt-spray fog test shall be in accordance with ASTM B117 using a 20 percent

sodium chloride solution. Immediately after completion of the test, the coating shall show no signs of blistering, wrinkling or cracking, no loss of adhesion, and the specimen shall show no signs of rust creepage beyond 3 mm (1/8-inch) on either side of the scratch mark.

E. Rooftop Unit: Air-conditioner shall be a factory packaged cooling combination heating and cooling unit as indicated and shall be suitable for mounting on roof of building with sloped roof curb. The package shall consist of one or more refrigerant compressors with electric motors, cooling coils, condensers, fans, filters, heating natural gas section, control wiring and piping, all factory assembled in a weatherproof enclosure mounted on a structural steel base ready for field connection to utilities and ducts. The package unit shall be sufficiently rigid and arranged to permit handling by a crane boom or by helicopter. **Provide the unit with Variable Volume, Variable Temperature (VVT) control panel, vibration isolation roof curbs, and flashing and transition plenums with flexible collars.**

1. Unit Enclosure: Construct enclosure with removable access panels completely weatherized for outside installation, and properly reinforced and braced. Provide panels and access door for inspection and access to all internal parts. Surface of steel parts shall be factory corrosion protected by a painting or coating system specified. Provide enclosure with adequate reinforced points of supports for setting of the unit. Joints shall be air and watertight.

2. Provide packaged rooftop units with product integrated controls (PIC) using Carrier or approved equal**,** Variable Volume, Variable Temperature (VVT) control technology as manufactured by Carrier Corp. or approved equal, diffuser section, outside air dampers and power exhaust to equalize resistance through cooling and heating passages and control to maintain acceptable carbon dioxide (CO2) levels (750 ppm or less in return air supply path or individual room CO2 sensors as shown on the drawings) using CO2 sensor(s).

F. Insulation: Apply in sufficient thickness and density to prevent condensate from forming on the unit casing from air entrance at coils to air outlet of unit. Insulation shall meet the requirements of NFPA 90A and be protected against deterioration and delamination from air currents. Insulate condensate drain pan with water impervious insulation of sufficient thickness to prevent condensate formation on the exterior at ambient conditions encountered.

G. Evaporator Fan: Forward curved type or backward inclined centrifugal type specifically designed and suitable for the operating pressure conforming to AMCA 210. For units less than five tons, direct drive with at least three speed taps may be used. Units shall have either greaseable or permanently lubricated ball or roller bearings. Statically balance fan assemblies in the fan housing and final assembly. Fan motors shall conform

to NEMA MG-1. Motor starters shall conform to NEMA ICS-1.

H. Compressors: Provide hermetic type conforming to ARI 520, provided with all the minimum standard equipment and accessories listed therein. Compressors shall be mounted with vibration isolation springs or approved equal. Compressor speed for compressors above 70.4 kW (20 tons) shall not exceed 1750 rpm. Provide compressors with cylinder unloading for automatic capacity reduction of at least 50 percent for units over 35.2 kW (10 tons). Compressors shall start unloaded to minimum step of unloading. If standard with the manufacturer, two or more compressors, but not more than four, may be provided in lieu of a single compressor with cylinder unloading in which case capacity reduction shall be provided by sequence operation of the compressor or combination of the two methods. Provide each compressor with independent refrigerant circuit. Where compressors are paralleled, provide not less than two independent refrigerant circuits. Provide each compressor with devices to protect the compressor from short-cycling when shut-down by safety controls. Provide a pump-down cycle of the non-recycling start type for each compressor 35.2 kW (10 tons) and over. Provide compressors with vibration isolators. Compressor motor shall be suitable for electric power characteristics as indicated. Motor shall conform to NEMA MG-1. Motor starters shall conform to NEMA ICS-1.

I. Filter Boxes: Provide filter boxes with either hinged access doors or removable panels. Filters shall be as specified in Section, AIR FILTERS.

J. Controls:

1. Rooftop unit shall be complete with Carrier manufacturer's or equal PIC and VVT controls. Mount all other controls including motor starters and safety controls inside the enclosure. All wiring inside enclosure shall be accomplished at the factory. Provide convenience electrical 120 volt outlet at the unit.
2. Condenser Controls: Provide head pressure control to insure condensing temperature for proper system operation at all ambient temperatures down to -18 degrees C (0 degrees F).
3. Condenser Start-Up Control: Provide condenser with a start-up control package which permits start-up of compressor at ambient temperature of –18 degrees C (0 degrees F). Package shall temporarily bypass system low pressure stat to permit start-up whenever minimum ambient temperature is below design evaporator coil suction temperature.

O. Refrigerant Circuits: Dehydrate entire refrigerant circuit, purge, and charge with refrigerant and oil at factory. Factory oil charge shall be the full amount required for operation. Factory charge for refrigerant shall be full amount required for operation, if within limits permitted by Interstate Commerce Commission, otherwise

furnish a holding charge of the type refrigerant to be used.

PART 3 - EXECUTION

3.1 INSTALLATION

Handle and install units and accessories in accordance with the manufacturer's printed instructions.

3.2 TESTS

Perform tests and make reports in accordance with Sections, BASIC METHODS AND REQUIREMENTS (MECHANICAL) and TESTING, ADJUSTING AND BALANCING.

END OF SECTION

SECTION 238239 - UNIT HEATERS

PART 1 – GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
1. Provide Payment and Performance Bonds for the full value of their Subcontract.
2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
1. Comply with the Instructions to Bidders.
2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
FILED SUBCONTRACTOR'S BID FOR SECTION:
23 82 39 – UNIT HEATERS

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
1. All subcontractors to the Filed Subcontractor, whose work is:
a. Valued at $10,000 or more.
2. The contract sum for each subcontractor required to be listed.
a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
4. Comply with the applicable General Laws and the following:
a. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

	Class of Work	Specification section number and name
a.	None.	None.

A. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. M1.00 – Mechanical Notes
2. M1.01 – Mechanical Details
3. M1.02 – Mechanical Specifications
4. M1.03 – Mechanical Zoning Plan
5. M2.00 – Mechanical Floor Plan
6. M2.01 – Mechanical Ventilation/Heating Plan
7. M2.02 – Mechanical Roof Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 23 00 00 – Common Work Results for HVAC
2. Section 23 05 13 – Common Motor Requirements for HVAC Equipment
3. Section 23 05 48 – Vibration and Controls for HVAC Piping and Equipment
4. Section 23 05 53 – Identification for HVAC Piping and Equipment
5. Section 23 05 93 – Testing, Adjusting, and Balancing for HVAC
6. Section 23 07 13 – Duct Insulation
7. Section 23 08 00 – Commissioning of HVAC
8. Section 23 09 00 – Instrumentation and Controls for HVAC
9. Section 23 31 13 – Metal Ducts
10. Section 23 33 00 – Air Duct Accessories
11. Section 23 34 23 – HVAC Power Ventilators
12. Section 23 37 13 – Diffusers, Registers, and Grilles
13. Section 23 37 23 – HVAC Gravity Ventilators
14. Section 23 34 00 – Particulate Air Filtration
15. Section 23 72 00 – Air-to-Air Energy Recovery Ventilator
16. Section 23 74 16 – Package Rooftop Air Conditioning Units
17. Section 23 82 39 – Unit Heaters

B. Alternates: None.

1.3 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.4 SUMMARY

A. Section Includes:

1. Wall and ceiling heaters with propeller fans and gas or electric-resistance heating coils.

1.5 DEFINITIONS

A. BAS: Building automation system.

B. CWP: Cold working pressure.

C. PTFE: Polytetrafluoroethylene plastic.

D. TFE: Tetrafluoroethylene plastic.

1.6 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Plans, elevations, sections, and details.
2. Location and size of each field connection.
3. Details of anchorages and attachments to structure and to supported equipment.
4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.
5. Location and arrangement of piping valves and specialties.
6. Location and arrangement of integral controls.
7. Wiring Diagrams: Power, signal, and control wiring.

C. Samples for Initial Selection: Finish colors for units with factory-applied color finishes.

D. Samples for Verification: Finish colors for each type of cabinet unit heater and wall and ceiling heaters indicated with factory-applied color finishes.

1.7 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which unit heaters will be attached.
3. Method of attaching hangers to building structure.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.

6. Perimeter moldings for exposed or partially exposed cabinets.

B. Field quality-control test reports.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, and maintenance manuals.

1.9 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Cabinet Unit Heater Filters: Furnish one spare filter(s) for each filter installed.

1.10 QUALITY ASSURANCE

A. 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.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

PART 2 - PRODUCTS

2.1 WALL AND CEILING HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Chromalox, Inc.; a division of Emerson Electric Company.
2. Markel Products; a division of TPI Corporation.
3. QMark Electric Heating; a division of Marley Engineered Products.

4. Trane.

B. Description: An assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.

C. Cabinet:

1. Front Panel: Stamped-steel louver or Extruded-aluminum bar grille, with removable panels fastened with tamperproof fasteners.
2. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Surface-Mounting Cabinet Enclosure: Steel with finish to match cabinet.

E. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 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.

F. Fan: Aluminum propeller directly connected to motor.

1. Motor: Permanently lubricated. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

G. Controls: Unit-mounted thermostat.

H. Electrical Connection: Factory wire motors and controls for a single field connection.

I. Capacities and Characteristics:

1. See schedule on drawings

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive unit heaters for compliance with requirements for tolerances and other conditions affecting performance.

B. Examine roughing-in for electrical connections to verify actual locations before unit heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Section 079200 "Joint Sealants."

B. Install cabinet unit heaters to comply with NFPA 90A.

C. Install propeller unit heaters level and plumb.

D. Suspend cabinet unit heaters from structure with elastomeric hangers. Vibration isolators are specified in Section 230548 "Vibration Controls for HVAC Piping and Equipment."

E. Suspend propeller unit heaters from structure with all-thread hanger rods and elastomeric hangers or spring hangers. Hanger rods and attachments to structure are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Section 230548 "Vibration Controls for HVAC Piping and Equipment."

F. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

G. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.3 CONNECTIONS

A. Install piping adjacent to machine to allow service and maintenance.

C. Connect piping to cabinet unit heater's factory, hot-water piping package. Install the piping package if shipped loose.

D. Connect supply and return ducts to cabinet unit heaters with flexible duct connectors specified in Section 233300 "Air Duct Accessories."

E. Comply with safety requirements in UL 1995.

F. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of unit heater. Hydronic specialties are specified in Section 232113 "Hydronic Piping."

G. Unless otherwise indicated, install union and gate or ball valve on steam-supply connection and union, strainer, steam trap, and gate or ball valve on condensate-return connection of unit heater. Steam

specialties are specified in Section 232213 "Steam and Condensate Heating Piping."

H. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

I. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

A. Adjust initial temperature set points.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION

SECTION 26 05 00 - BASIC METHODS AND REQUIREMENTS (ELECTRICAL

PART 1 - **GENERAL**
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
   1. Provide Payment and Performance Bonds for the full value of their Subcontract.
   2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
   1. Comply with the Instructions to Bidders.
   2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
   3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
   4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
      FILED SUBCONTRACTOR'S BID FOR SECTION:
      26 05 00 – Basic Methods and Requirements (Electrical)

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
   1. All subcontractors to the Filed Subcontractor, whose work is:
      a. Subject to the provisions of MGL Chap. 149, §§ 44A-J.
      b. Valued at $10,000 or more.
   2. The contract sum for each subcontractor required to be listed.
      a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
   3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
   4. Comply with the applicable Mass. General Laws and the following:

a. Sub bidder's attention is directed to Massachusetts G.L. Chapter 149 Section 44F, as amended, which provides in part as follows.

b. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

	Class of Work	Specification section number and name
a.	None.	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. E1.01 – Lighting Plan
2. E2.01 – Power Plan
3. E2.02 – Power Roof Top Plan
4. E3.00 – Electrical Details
5. E4.00- Electrical Notes
6. FA1.01- Fire Alarm Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 26 05 00 – Basic Method and Requirements (Electrical)
2. Section 26 05 21 – Cables, Low Voltage (600 Volts and Below)
3. Section 26 05 26 – Grounding
4. Section 26 05 33 – Raceway Systems
5. Section 26 05 41 – Underground Electrical Construction
6. Section 26 22 00 – Low-Voltage Transformers
7. Section 26 24 16 – Panelboards
8. Section 26 27 26 – Wiring Devices
9. Section 26 29 21 – Disconnects (Motor and Circuit)
10. Section 26 32 13 – Engine Generators
11. Section 26 36 23 – Automatic Transfer Switches

12. Section 26 51 00 – Interior Lighting
13. Section 28 31 64 – Fire Alarm Local Building System

B. Alternates: None.

1.3 DESCRIPTION (SCOPE OF WORK)

A. Furnish all labor, materials, services and skilled supervision necessary for the construction, erection, installation, connection, testing, and adjustments needed to install electrical wiring, raceways, devices, fixtures, system components, equipment and accessories necessary to provide a complete, safe, operational electrical installation in accordance with the intent of the specifications and drawings. The word furnish is defined to mean provide and install the related item.

B. Each system shall be installed in a manner which will fully comply with all applicable requirements of NFPA, ADA, IBC, Local Standards, Industry Standards, manufacturer's recommendations, and project drawings and specifications.

C. Electrical service entrance equipment (arrangements for temporary and permanent connections to the power company's system) shall conform to the power company's requirements. Coordinate fuses, circuit breakers and relays with the power company's system, and obtain power company approval.

D. Wiring ampacities specified or shown on the drawings are based on copper conductors with 75 degree C insulation, with the conduit and raceways accordingly sized. With the exception of service entrance conductors, aluminum conductors are prohibited unless specifically identified on the drawings. For service entrance conductors, aluminum conductors of equal or greater ampacity may be used (with corresponding adjustments to quantities and conduit requirements) in configurations acceptable to the utility company.

E. Make final connections to equipment supplied by others. Controls and starters related to mechanical equipment shall be supplied by the mechanical contractor. Controls and starters for owner furnished equipment shall be supplied by others. Electrical contractor shall make electrical connections to equipment from point of electrical circuit shown on drawings for equipment. Electrical contractor shall make connections to owner furnished equipment serviced by either hard wiring or service cord drops. Electrical contractor shall provide means of disconnection of equipment from electrical circuit if starter or controller

supplied with equipment does not meet NEC requirements for disconnect.

F. Procure and pay for all permits and certificates necessary to construct and place in operation all work to be done under this DIVISION. Pay for all legally imposed charges made by the local authorities for full inspection and approval services of the bureaus administering applicable codes and regulations. This shall include the cost and back charge of installing any portion of the work where performed by county or municipal utility departments, and utility companies.

1.4 MINIMUM REQUIREMENTS

A. References to the National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL), and National Fire Protection Association (NFPA) are a minimum installation requirement standard. Applicable reference documents shall be those in effect as of the date of the contract award.

B. The installation shall conform to the latest requirements of all applicable federal, state, and local codes, laws and regulations governing standards of design, construction, workmanship, materials, types of equipment, and methods of installation in effect for the project location at the time of the contract award. These include, but are not limited to: The International National Building Code, NFPA 70 (NEC), NFPA 101, NFPA 72, and ADA requirements unless more stringent requirements are indicated herein or shown.

C. Drawings and other specification sections shall govern in those instances where requirements are greater than those specified in NEC.

1.5 MATERIAL STANDARDS

A. All components of the installation shall be new. All electrical apparatus furnished under this DIVISION shall be approved by the UL and shall be so labeled or listed where such is applicable. Where custom-built equipment is specified and the UL label or listing is not applicable to the completed product, all components used in the construction of such equipment shall be labeled or listed by UL where applicable. The label or listing of the Underwriters Laboratories, Inc., shall be accepted as evidence that the materials or equipment conform to the

applicable standards of that agency. In lieu of this label or listing, a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures and that the materials and equipment comply with all contract requirements will be accepted. For other than equipment and materials specified to conform to UL publications, a manufacturer's statement indicating complete compliance with the applicable Federal Specification, or standard of the American Society for Testing and Materials, National Electrical Manufacturers Association, or other commercial standard, is acceptable. Materials and equipment shall be approved based on the manufacturer's published data.

1.6 DEFINITIONS

A. Listed; equipment or device of a kind mentioned which:

1. Is published by a nationally recognized laboratory which makes periodic inspection of production of such equipment.
2. States that such equipment meets nationally recognized standards or has been tested and found safe for use in a specified manner.

B. Labeled; equipment or device is when

1. It embodies a valid label, symbol, or other identifying mark of a nationally recognized testing laboratory such as Underwriters Laboratories, Inc.
2. The laboratory makes periodic inspections of the production of such equipment.
3. The labeling indicates compliance with nationally recognized standards or tests to determine safe use in a specified manner.

C. Certified; equipment or product is which:

1. Has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards or to be safe for use in a specified manner.
2. Production of equipment or product is periodically inspected by a nationally recognized testing laboratory.
3. Bears a label, tag, or other record of certification.

D. Nationally recognized testing laboratory; which is approved, in accordance with OSHA regulations, by the Secretary of Labor.

1.7 QUALIFICATIONS (PRODUCTS AND SERVICES)

A. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.

B. Product Qualification

a. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
b. The Owner reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.

C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within four hours of receipt of notification that service is needed. Submit name and address of service organizations.

D. The contractor, by accepting this work, represents that he is qualified to successfully accomplish the work without additional direction by the design engineer. The design engineer is not responsible for means, method, techniques, or procedures used by the contractor during construction.

1.8 MANUFACTURED PRODUCTS

A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts should be available.

B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.

C. Equipment Assemblies and Components:

1. Components of an assembled unit need not be products of the same manufacturer.
2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
3. Components shall be compatible with each other and with the total assembly for the intended service.
4. Constituent parts which are similar shall be the product of a single manufacturer.

D. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.

1.9 VARIATIONS/ALTERNATES

A. Where variations from the contract requirements are requested, the connecting work and related components shall be included. The requested variation shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods. The impact and cost of the requested variation shall be included in the request for variation.

1.10 EQUIPMENT PROTECTION

A. Equipment and material shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain.

B. During installation, enclosures, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter; and be vacuum cleaned both inside and outside before testing, operating and painting.

C. Damaged equipment shall be placed in first class operating condition or be returned to the source of supply for repair or replacement.

D. Painted surfaces shall be protected with factory installed removable heavy protective paper, sheet vinyl, or equivalent covering.

E. Damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so that repaired areas are not obvious.

1.11 WORK PERFORMANCE

A. The drawings indicate the extent and the general location and arrangement of equipment, conduit, and wiring. The Contractor shall become familiar with all details of the work and verify all dimensions in the field so that outlets, components, disconnects, raceways and equipment shall be properly located and readily accessible.
   1. Final locations of all equipment requiring electrical connections shall be confirmed with the installing trade prior to rough in or installation of associated disconnects, wiring, raceways, etc. Contractor shall be responsible for any re-work require resulting from failure to coordinate. Conflicts shall be reported to the Engineer prior to execution of work.
   2. Over-current protective device ratings for all equipment requiring electrical connections shall be confirmed with the installing trade prior to ordering protective devices and rough in of circuit conductors, raceways, disconnects, and associated devices. Contractor shall be responsible for any re-work require resulting from failure to coordinate. Conflicts shall be reported to the Engineer prior to execution of work.

   3. Lighting fixtures, outlets, and other equipment and materials shall be located to avoid interference with mechanical or structural features; otherwise, lighting fixtures shall be symmetrically located according to the room arrangement where uniform illumination is required, or asymmetrically located to suit conditions fixed by design and shown.

   4. Raceways, junction and outlet boxes, and lighting fixtures shall not be supported from sheet metal roof decks.

   5. The Electrical Contractor shall coordinate the electrical work with HVAC and electrical drawings and provide all power related wiring even if it is not shown on electrical drawings. If any conflicts occur necessitating departures from the drawings, details of and

reasons for departures shall be submitted and approved prior to implementing any change.

B. The drawings are diagrammatic only, intending to show general runs and locations of circuits, equipment, fixtures, and devices; and do not necessarily show all required offsets, routing, details, fire-stopping, and mounting requirements. The electrical contractor is responsible for determining the optimal routing of circuits and field investigations required to complete the installation in a professional workmanship manner.
    1. The Contractor shall refer to architectural drawings for additional dimensions and mounting locations.
    2. The Contractor shall coordinate with cabinet installers for locations of outlets and devices integral to or immediately adjacent to casework, counter, or cabinet installations.
    3. The exact location and mounting height of all lighting fixtures shall be coordinated with architectural reflected ceiling plans, architectural details, mechanical and plumbing plans prior to installation of fixtures.
    4. All door swings shall be verified on site prior to rough-in of light switches.
    5. All work shall be accurately laid out with reference to the drawings and in cooperation with other trades to avoid conflicts and to obtain a neat and workable installation which will afford maximum accessibility for operation, maintenance and headroom.
    6. Coordinate installation of electrical equipment, conduit, wiring, and devices with other trades to avoid interference. The contractor shall coordinate with the mechanical contractor for final locations and connection requirements of mechanical equipment.

C. The drawings are not intended to be rigid in specific details. Where they are in conflict with requirements of other drawings, or with any applicable code or with recommendations of the manufacturers of any equipment actually furnished, installed or connected under this DIVISION, make such adjustments as may be required to insure that all such equipment installed and connected is in conformance with such codes or recommendations, for safe, proper, and efficient operation of the equipment. In the event of conflict between various parts of the contract documents, including but not limited to drawings and general provisions, the more stringent (more costly) of the conditions shall apply for bidding purposes. The contractor shall request clarification for all conflicts prior to construction. Failure to request clarification shall not relieve the contractor of the requirement to provide the more costly implementation. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change.

D. New work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior condition.

E. All cutting and patching incidental to and required for the proper installation of the work of this DIVISION shall be performed under this DIVISION. All work of this DIVISION shall be fully coordinated with the work of other trades and with all phases of construction in order to minimize the amount of cutting and patching. Coordinate with the Contractor to assure all requirements relating to cutting and patching are satisfied.

F. Work done by others on the premises, including the buildings, grounds and appurtenances, shall be protected from damage which might be done or caused by work performed under this DIVISION. Provide protective materials and coverings where necessary, to guard building surfaces and building contents from damages due to the operations of this work. Any and all such damages which occur shall be repaired by approved methods so as to restore the damaged areas to their original condition. The Contractor shall be held responsible for and shall pay for all damage to other work caused by his work or workmen. Repairing of such damage shall be done by workmen skilled in the trade required for the repair and shall be performed according to the directions of the Architect.

G. Clear away all debris and surplus materials resulting from the performance of this work leaving the job and equipment furnished under this DIVISION in a clean, first-class condition. All materials excess to the needs of this project shall be removed from the premises and disposed of. After all debris is removed, the building shall be left broom clean.

H. Coordinate location of equipment and conduit with other trades to minimize interferences.

I. Where conduits, wireways, and other electrical raceways pass through fire rated partitions, floors, or ceilings, provide UL listed fire stop assemblies of equal fire rating. Completely fill and seal clearances between raceways with approved fire stopping material.

1.12 EQUIPMENT INSTALLATION AND REQUIREMENTS

A. Equipment location shall be as close as practical to locations shown on the drawings.

B. Working spaces shall not be less than specified in the NEC for all voltages specified.

1.13 EQUIPMENT IDENTIFICATION

A. In addition to the requirements of the NEC, install an identification sign which will clearly indicate information required for use and maintenance of items such as panelboards, cabinets, motor controllers (starters), safety switches, separately enclosed circuit breakers, individual breakers and controllers in switchgear and motor control assemblies, control devices and other significant equipment.

B. Major items of electrical equipment and major components shall be permanently marked with an identification name to identify the equipment by type or function, specific unit number, and circuit designator as indicated. Designation of motors shall coincide with their designation in the motor control center or panel. Unless otherwise specified, all identification nameplates shall be made of laminated plastic with black outer layers and a white core. Plates shall be fastened with screws, except motors which shall be attached with metal fasteners.

C. The Engineer's approval shall be obtained for all equipment and material before delivery to the job site.

D. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Owner to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.

E. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.

F. The submittals shall include the following
   1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.

2. Elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
3. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.

1.14 TEST

A. After the wiring system installation is completed the Contractor shall conduct an operating test for approval. The equipment shall be demonstrated to operate in accordance with the requirements of the project. The Contractor shall furnish all instruments and personnel required for the tests, and the owner will furnish the necessary electric power. No part of the electrical distribution system shall be energized prior to the resistance testing of that system's ground rods.

B. The Contractor shall perform all tests required for final acceptance testing by the jurisdiction having authority or other tests directed by the Engineer.

1.15 WARRANTY

A. The contractor shall warrant the complete electrical installation at the time of completion for a period of one year. During the warranty period the contractor shall replace or repair any components or work which develop defects beyond normal wear and tear. The electrical contractor shall be responsible for, and shall incur financial responsibility for any damages caused by or resulting from defects in his work.

END OF SECTION

SECTION 26 05 21 - CABLES, LOW VOLTAGE (600 VOLTS AND BELOW)

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
   1. Provide Payment and Performance Bonds for the full value of their Subcontract.
   2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
   1. Comply with the Instructions to Bidders.
   2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
   3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
   4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
      FILED SUBCONTRACTOR'S BID FOR SECTION:
      26 05 21 – CABLES, LOW VOLTAGE (600 VOLTS AND BELOW)

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
   1. All subcontractors to the Filed Subcontractor, whose work is:
      a. Subject to the provisions of MGL Chap. 149, §§ 44A-J.
      b. Valued at $10,000 or more.
   2. The contract sum for each subcontractor required to be listed.
      a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
   3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
   4. Comply with the applicable Mass. General Laws and the following:
      a. Sub bidder's attention is directed to Massachusetts G.L. Chapter 149 Section 44F, as amended, which provides in part as follows.
      b. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications,

any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None**.**	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. E1.01 – Lighting Plan
2. E2.01 – Power Plan
3. E2.02 – Power Roof Top Plan
4. E3.00 – Electrical Details
5. E4.00- Electrical Notes
6. FA1.01- Fire Alarm Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 26 05 00 – Basic Method and Requirements (Electrical)
2. Section 26 05 21 – Cables, Low Voltage (600 Volts and Below)
3. Section 26 05 26 – Grounding
4. Section 26 05 33 – Raceway Systems
5. Section 26 05 41 – Underground Electrical Construction
6. Section 26 22 00 – Low-Voltage Transformers
7. Section 26 24 16 – Panelboards
8. Section 26 27 26 – Wiring Devices
9. Section 26 29 21 – Disconnects (Motor and Circuit)
10. Section 26 32 13 – Engine Generators
11. Section 26 36 23 – Automatic Transfer Switches
12. Section 26 51 00 – Interior Lighting
13. Section 28 31 64 – Fire Alarm Local Building System

B. Alternates: None.

1.3 DESCRIPTION

A. This section includes the furnishing, installation, and connection of the low voltage power and lighting wiring.

1.4 RELATED WORK

B. General electrical requirements that are common to more than one section in Division 26.

1.5 APPLICABLE PUBLICATIONS

The publications listed below form a part of this specification to the extent referenced. Except where a specific date is given, the issue in effect (including amendments, addenda, revisions, supplements, and errata) on the date of Invitation for Bids shall be applicable. The publications are referenced in the text by designation only.

A. National Fire Protection Association (NFPA):

70 National Electrical Code (NEC)

B. Underwriters Laboratories, Inc. (UL):

44 Rubber Insulated Wire and Cables

83 Thermoplastic insulated Wires

486A Wire Connectors and Soldering Lugs for Use with copper

486B Splicing Wire Connectors

486D Insulated Wire Connectors for Use with Underground Conductors

493 Thermoplastic Insulated Underground Feeder and Branch Circuit Cables

PART 2. PRODUCTS

2.1. CABLE AND WIRE (POWER AND LIGHTING)

A. Cable and Wire: except as hereinafter specified.

B. Single Conductor:

1. Annealed copper.
2. Stranded for sizes No. 8 and larger. Solid for sizes No. 10 and smaller.
3. Minimum size No. 12, except where larger gauge sizes are shown.

C. Non-metallic Cable

1. Type NM-B. PVC jacket with nylon covered THHN insulation.
2. UL 719 Conductors per ASTM B-3

D. Type MC Cable: UL Standard 83, UL Standard 1063, UL Standard 1569

E. Insulation:

1. THW, XHHW, or dual rated THHN THWN, UL 44, 83 and 493.
2. Direct burial: UF or USE.
3. Isolated power system wiring: Type XHHW with a dielectric constant of 3.5 or less.

F. Color code:

1. Secondary service, feeder, and branch circuit conductors, be color coded as follows:

208/120 volt	Phase	480/277 volt
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray *

* or white with colored (other than green) tracer.

2. Use solid color compound or solid color coating for No. 12 and No. 10 branch circuit conductors and neutral sizes.
3. Phase conductors No. 8 and larger color code using one of the following:
   a. Solid color compound or solid color coating.
   b. Stripes, bands, or hash marks of color specified above.
   c. Colored as specified using 3/4 inch wide tape. Apply tape in half overlapping turns for a minimum of three inches for terminal points, and in junction boxes, pull boxes, troughs, manholes, and handholes. Apply the last two laps of tape with no tension

to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable stating size and insulation type.

4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
5. Color code for isolated power system wiring, in accordance with the NEC.

2.2. SPLICES AND JOINTS

A. In accordance with UL 486 A, B, D and NEC.

B. Branch circuits (No. 10 and smaller):

1. Connectors: Solderless, screw on, reusable pressure cable type, 600 volt, 105 degree C with integral insulation, approved for copper and aluminum conductors.
2. The integral insulator shall have a skirt to completely cover the stripped wires.
3. The number, size, and combination of conductors, as listed on the manufacturers packaging shall be strictly complied with.

C. Feeder Circuits:

1. Connectors shall be indent, hex screw, or bolt clamp type of high conductivity and corrosion resistant material.
2. Field installed compression connectors for cable sizes 250 MCM and larger shall have not less than two clamping elements or compression indents per wire.
3. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Insulate with not less than that of the conductor level that is being joined.
4. Plastic electrical insulating tape: Fed Spec. HH I 595 shall apply, flame retardant, cold and weather resistant.

2.3. CONTROL WIRING

A. Unless otherwise specified in other sections of these specifications, size control wiring as specified for power and lighting wiring, except the minimum size shall be not less than No. 14.

B. Size wire large enough so that the voltage drop under inrush conditions does not adversely affect operation of the controls.

2.4. WIRE LUBRICATING COMPOUND

A. Suitable for the wire insulation and conduit it is used with, and shall not harden or become adhesive.
B. Shall not be used on wire for isolated type electrical power systems.

PART 3. EXECUTION

3.1. INSTALLATION, GENERAL

A. Install in accordance with the NEC, and as specified.

B. Install wiring in raceway systems as shown.

C. Splice cables and wires only in outlet boxes, junction boxes, pull boxes, manholes, or handholes.

D. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.

E. For panelboards, cabinets, wireways, switches, and equipment assemblies, neatly form and train conductors.

F. Seal cable and wire entering a building from underground between the wire and conduit, where the cable exits the conduit, with a nonhardening approved compound.

G. Provide fireproofing with UL listed materials where conductors or raceways penetrate fire rated assemblies.

H. Wire Pulling:

1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
2. Use ropes for pulling feeders made of nonmetallic material.
3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the Engineer.
4. Pull in together multiple cables in a single conduit.

3.2. SPLICE INSTALLATION

A. Splices and terminations shall be mechanically and electrically secure.

B. Where the Engineer determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices at no additional cost to the Owner.

3.3. FEEDER IDENTIFICATION

A. In each interior, pullbox and junction box, install metal tags on each circuit cables and wires to clearly designate their circuit identification and voltage.

B. In manholes and handholes, provide tags of the embossed brass type, and also show the cable type and voltage rating. Attach the tags to the cables with slip free plastic cable lacing units.

3.4. DIRECT BURIAL CABLE INSTALLATION

A. Tops of the cables:

1. Below the finished grade: Minimum 600 mm (24 inches) unless greater depth is shown.
2. Below road and other pavement surfaces: In conduit as specified, minimum 30 inches unless greater depth is shown.
3. Do not install under railroad tracks.

B. Under road and paved surfaces, install the cables in PVC coated galvanized steel rigid conduits, not less than two inch trade size with bushings at each end of each conduit run.

C. Work with extreme care near existing ducts, conduits, cables and other utilities to prevent any damage.

D. Cut the trenches neatly and uniformly:

1. Place a three inch layer of sand in the trenches before installing the cables.
2. Place a three inch layer of sand over the installed cables.
3. Install continuous horizontal, warning tape three inches above the installed cables before backfilling.

E. Provide horizontal slack in the cables for contraction during cold weather.

F. Install the cables in continuous lengths. Splices within cable runs will not be accepted.

G. Connections and terminations shall be submersible type designed for the cables being installed.

3.5. FIELD TESTING

A. Feeders and branch circuits shall have their insulation tested after installation and before connection to utilization devices such as fixtures, motors, or appliances.

B. Test conductors phase to phase and phase to ground.

END OF SECTION

SECTION 26 05 26 – GROUNDING

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
   1. Provide Payment and Performance Bonds for the full value of their Subcontract.
   2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
   1. Comply with the Instructions to Bidders.
   2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
   3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
   4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
      FILED SUBCONTRACTOR'S BID FOR SECTION:
      26 05 26 – Grounding

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
   1. All subcontractors to the Filed Subcontractor, whose work is:
      a. Subject to the provisions of MGL Chap. 149, §§ 44A-J.
      b. Valued at $10,000 or more.
   2. The contract sum for each subcontractor required to be listed.
      a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
   3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
   4. Comply with the applicable Mass. General Laws and the following:
      a. Sub bidder's attention is directed to Massachusetts G.L. Chapter 149 Section 44F, as amended, which provides in part as follows.
      b. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such

listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None**.**	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. E1.01 – Lighting Plan
2. E2.01 – Power Plan
3. E2.02 – Power Roof Top Plan
4. E3.00 – Electrical Details
5. E4.00- Electrical Notes
6. FA1.01- Fire Alarm Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 26 05 00 – Basic Method and Requirements (Electrical)
2. Section 26 05 21 – Cables, Low Voltage (600 Volts and Below)
3. Section 26 05 26 – Grounding
4. Section 26 05 33 – Raceway Systems
5. Section 26 05 41 – Underground Electrical Construction
6. Section 26 22 00 – Low-Voltage Transformers
7. Section 26 24 16 – Panelboards
8. Section 26 27 26 – Wiring Devices
9. Section 26 29 21 – Disconnects (Motor and Circuit)
10. Section 26 32 13 – Engine Generators
11. Section 26 36 23 – Automatic Transfer Switches
12. Section 26 51 00 – Interior Lighting
13. Section 28 31 64 – Fire Alarm Local Building System

B. Alternates: None.

1.3 DESCRIPTION

This section specifies general grounding and bonding requirements of electrical installations.

1.4 RELATED WORK

General electrical requirements that are common to more than one section in DIVISION 26: Section 26 05 00, BASIC METHODS AND REQUIREMENTS (ELECTRICAL).

1.5 APPLICABLE PUBLICATIONS

The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

A. National Fire Protection Association (NFPA):

70.....National Electrical Code (NEC)

B. Underwriters Laboratories, Inc. (UL):

83 .....Thermoplastic Insulated Wires and Cables

44.....Rubber Insulated Wires and Cables

467.....Grounding and Bonding Equipment

PART 2. PRODUCTS

2.1. GROUNDING WIRES

A. General Purpose: UL and NEC approved types, copper, with TW, THW, XHHW or dual rated THHN THWN insulation color identified green.

B. Size wire not less than what is shown and not less than required by the NEC.

2.2. GROUND RODS

A. Copper-clad steel, 5/8 inch diameter by 8 feet long.

PART 3. EXECUTION

3.1. INSTALLATION, GENERALLY

A. Ground in accordance with the NEC as shown, and as hereinafter specified.

B. System Grounding:

1. Secondary service neutrals ground at the supply side of the secondary disconnecting means and at the related transformers.
2. Separately derived systems (transformers downstream from the service entrance) ground the secondary neutral.
3. Isolation transformers and isolated power systems shall not be system grounded.

C. Equipment Grounding:

1. Metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be grounded for personnel safety and to provide a low impedance path for possible ground fault currents.

3.2. SECONDARY EQUIPMENT AND CIRCUITS

A. Main Bonding Jumper: Connect the secondary service neutral to the ground bus in the service equipment and separately derived systems.

B. Water Pipe and Supplemental Electrode:

1. Provide a ground conductor connection between the service equipment ground bus and the metallic water pipe system. Jumper insulating joints in the water pipe.
2. Provide a supplemental ground electrode and bond to the water pipe ground, or connect to the service equipment ground bus.

C. Transformers:

1. Exterior: Exterior transformers supplying interior service equipment shall also have the neutral grounded at the transformer secondary. Provide a grounding electrode at the transformer.
2. Separately derived systems (transformers downstream from service equipment): Ground the secondary neutral at the transformer. Provide a grounding electrode conductor from the transformer to the nearest cold water pipe.

D. Conduit Systems:

1. Ground all metallic conduit systems.
2. Non-metallic conduit systems shall contain a grounding conductor.
3. Conduit provided for mechanical protection containing only a grounding conductor, bond to that conductor at the entrance and exit from the conduit.

E. Feeders and Branch Circuits: Install green grounding conductors with feeders and branch circuits as indicated in panel schedules.

F. Boxes, Cabinets, Enclosures, and Panelboards:

1. Bond the grounding wires to each pullbox, junction box, outlet box, cabinets, and other enclosures through which the ground wires pass.
2. Provide ground bars in panelboards, bolted to the housing, with sufficient lugs for terminating the ground wires.

G. Motors and Starters:

1. Provide lugs in motor terminal box and starter housing for ground wire termination.
2. Make ground wire connections to ground bus in motor control centers.

H. Receptacles are not approved for grounding through their mounting screws. Ground with a ground wire from green ground terminal on the receptacle to the outlet box ground screw.

I. Ground lighting fixtures to the grounding conductor of the wiring system. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.

J. Fixed electrical appliances and equipment shall have a ground lug installed for termination of the green ground conductor.

3.3. CONDUCTIVE PIPING

A. Bond all conductive piping systems in the building to the electrical system ground. Bonding connections shall be made as close as practical to the water pipe ground or service equipment ground bus.

3.4. GROUND ROD INSTALLATION

A. Drive each rod vertically in the earth for not less than ten feet in depth.

B. Where permanently concealed ground connections are required, make the connections by the exothermic process to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connectors.

C. Where rock prevents the driving of vertical ground rods, install grounding electrodes in horizontal trenches to achieve the specified resistance.

END OF SECTION

SECTION 26 05 33 - RACEWAY SYSTEMS

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
   1. Provide Payment and Performance Bonds for the full value of their Subcontract.
   2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
   1. Comply with the Instructions to Bidders.
   2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
   3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
   4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
      FILED SUBCONTRACTOR'S BID FOR SECTION:
      26 05 21 – CABLES, LOW VOLTAGE (600 VOLTS AND BELOW)

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
   1. All subcontractors to the Filed Subcontractor, whose work is:
      a. Subject to the provisions of MGL Chap. 149, §§ 44A-J.
      b. Valued at $10,000 or more.
   2. The contract sum for each subcontractor required to be listed.
      a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
   3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
   4. Comply with the applicable Mass. General Laws and the following:
      a. Sub bidder's attention is directed to Massachusetts G.L. Chapter 149 Section 44F, as amended, which provides in part as follows.

b. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None.	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. E1.01 – Lighting Plan
2. E2.01 – Power Plan
3. E2.02 – Power Roof Top Plan
4. E3.00 – Electrical Details
5. E4.00- Electrical Notes
6. FA1.01- Fire Alarm Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 26 05 00 – Basic Method and Requirements (Electrical)
2. Section 26 05 21 – Cables, Low Voltage (600 Volts and Below)
3. Section 26 05 26 – Grounding
4. Section 26 05 33 – Raceway Systems
5. Section 26 05 41 – Underground Electrical Construction
6. Section 26 22 00 – Low-Voltage Transformers
7. Section 26 24 16 – Panelboards
8. Section 26 27 26 – Wiring Devices
9. Section 26 29 21 – Disconnects (Motor and Circuit)
10. Section 26 32 13 – Engine Generators
11. Section 26 36 23 – Automatic Transfer Switches
12. Section 26 51 00 – Interior Lighting
13. Section 28 31 64 – Fire Alarm Local Building System

B. Alternates: None.

1.3 DESCRIPTION

A. This section includes the furnishing, installation, and connection of conduit, fittings, and boxes to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise, such as by type MC or NM in panel schedules.

B. Definitions: The term conduit, as used in this specification, shall mean any or all of the types raceway types specified.

1.4 RELATED WORK

A. General electrical requirement and items that are common to more than one section of DIVISION 26: Section 26 05 00, BASIC METHODS AND REQUIREMENTS (ELECTRICAL).

B. Requirements for personnel safety and to provide a low impedance path for possible ground fault currents: Section 26 05 26: GROUNDING.

1.5 APPLICABLE PUBLICATIONS: The publication listed below form a part of this specification to the extent referenced. Except where a specific data is given, the issue in effect (including amendments, addenda, revisions, supplements, and errata) on the date of Invitation for Bids shall be applicable. The publications are referenced in the text by the basic designation only.

A. National Fire Protection Association (NFPA):

70.....National Electrical Code (NEC)

B. Underwriters Laboratories, Inc. (UL):

1..... Flexible Metal Electrical Conduit

5..... Surface Metal Electrical Raceway and Fittings

6 ..... Rigid Metal Conduit

50..... Electrical Cabinets and Boxes

467..... Electrical Grounding and Bonding Equipment

514A..... Metallic Outlet Boxes

514B.....Fittings for Conduit and Outlet Boxes

651.....Schedule 40 and 80 Rigid PVC Conduit

651A.....Type EB and A Rigid PVC Conduit

797.....Electrical Metallic Tubing

1242.....Intermediate Metal Conduit

C. National Electrical Manufacturers Association (NEMA)

TC 13……Electrical Nonmetallic Tubing (ENT)

PART 2. PRODUCTS

2.1. MATERIAL

A. Conduit Size: In accordance with the NEC, but not less than 3/4 inch unless otherwise shown. Where permitted by the NEC, 1/2 inch flexible conduit may be used for tap connections to recessed lighting fixtures.

B. Conduit:
1. Rigid steel: UL 6.
2. Rigid intermediate steel conduit (IMC): UL 1242.
3. Electrical metallic tubing (EMT): U.L. 797. Maximum size 5 inch. Permitted only with cable rated 600 volts or less.
4. Flexible steel conduit (commercial Greenfield): UL 1.
5. Liquid tight flexible metal conduit: Flexible galvanized steel tubing covered with extruded liquid tight jacket of polyvinyl chloride (PVC). Provide conduit with a continuous copper bonding conductor wound spirally between the convolutions.
6. Direct burial plastic conduit: UL 651, and UL 651A, heavy wall PVC or high density PE.

7. Surface metal raceway: UL 5.

C. Conduit Fittings:
   1. Rigid steel and IMC conduit fittings:
      a. Standard threaded couplings, locknuts, bushings, and elbows: Steel or malleable iron are acceptable. Integral retractable type IMC couplings are acceptable also.
      b. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
      c. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
      d. Erickson (union type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
      e. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank coverplates having the same finishes as that of other electrical plates in the room.
   2. Rigid aluminum conduit fittings:
      a. Standard threaded couplings, locknuts, bushings, and elbows: Malleable iron, steel or aluminum alloy materials. Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
      b. Locknuts and bushings: As specified for rigid steel and IMC conduit.
      c. Set screw fittings: Not permitted for use with aluminum conduit.
   3. Electrical metallic tubing fittings:
      a. Material of steel or malleable iron is acceptable.
      b. Couplings and connectors: Concrete tight and rain tight, with connectors having insulated throats. Use gland and ring compression type couplings and connectors for conduit sizes 2 inches and smaller. Use set screw type couplings with four set screws each for conduit sizes over 2 inches. Use set screws of case hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
      c. Indent type connectors or couplings are prohibited.
      d. Die cast or pressure cast zinc alloy fittings or fittings made of "pot metal" are prohibited.
   4. Flexible steel conduit (Greenfield) fittings:
      a. UL 5, except only steel or malleable iron material is acceptable.

b. Clamp type, with insulated throat.

5. Liquid tight flexible metal conduit fittings:
   a. Steel or malleable iron material is acceptable.
   b. Type incorporating a threaded grounding cone, a steel or plastic compression ring, and gland for tightening. Connectors shall have insulated throats.
   c. Direct burial plastic conduit fittings: As recommended by the conduit manufacturer.
6. Surface metal raceway fittings: As recommended by the raceway manufacturer.
7. Expansion and deflection couplings:
   a. UL 467 and UL 514.
   b. Accommodate, 0.75 inch deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
   c. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, and the NEC code tables for ground conductors.
   d. Jacket: Flexible, corrosion resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.

D. Conduit Supports:
   1. Parts and hardware: Zinc coat or provide equivalent corrosion protection.
   2. Individual Conduit Hangers: Designed for the purpose, having a pre assembled closure bolt and nut, and provisions for receiving a hanger rod.
   3. Multiple conduit (trapeze) hangers: Not less than 1 1/2 by 1 1/2 inch, 12 gage steel, cold formed, lipped channels; with not less than 3/8 inch diameter steel hanger rods.
   4. Solid Masonry and Concrete Anchors: Self drilling expansion shields, or machine bolt expansion.

E. Outlet, Junction, and Pull Boxes:
   1. UL 50, UL 514A
   2. Cast metal where required by the NEC or shown, and equipped with rustproof boxes.
   3. Sheet metal boxes: Galvanized steel, except where otherwise shown.

F. Wireways: Equip with hinged covers, except where removable covers are shown.

PART 3. EXECUTION

3.1. PENETRATIONS

A. Cutting or Holes:

1. Locate holes in advance where they are proposed in the structural sections such as ribs or beams. Obtain the approval of the Engineer prior to drilling through structural sections.
2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed, except where permitted by the Engineer as required by limited working space.

B. Fire Stop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases with rock wool fiber or silicone foam sealant only. Completely fill and seal clearances between raceways and openings with the fire stop material.

C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal clearances around the conduit and make watertight.

3.2. CONDUIT SYSTEMS INSTALLATION, GENERAL

A. Installation: In accordance with UL, NEC, as shown, and as hereinafter specified.

B. Install conduit as follows:
1. In complete runs before pulling in cables or wires.
2. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new undamaged material.
3. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
4. Cut square with a hacksaw, ream, remove burrs, and draw up tight.
5. Mechanically and electrically continuous.
6. Independently support conduit. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, mechanical piping, or mechanical ducts).
7. Support within one foot of changes of direction, and within one foot of each enclosure to which connected.
8. Close ends of empty conduit with plugs or caps at the rough in stage to prevent entry of debris, until wires are pulled in.
9. Secure conduits to cabinets, junction boxes, pull boxes and outlet boxes with bonding type locknuts. For rigid and IMC conduit installations, provide a locknut on the inside of

the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.

C. Conduit Bends:
   1. Make bends with standard conduit bending machines.
   2. Conduit hickey may be used for slight offsets, and for straightening stubbed out conduits.
   3. Bending of conduits with a pipe tee or vise is prohibited.

D. Layout and Homeruns:
   1. Install conduit with wiring for homeruns grouped as shown.
   2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted to and have been approved by the Engineer.

3.3. CONCEALED WORK INSTALLATION

A. In Concrete:
   1. Conduit: Rigid steel, IMC or EMT; except do not install EMT in concrete slabs that are in contact with soil, gravel or vapor barriers.
   2. Align and run conduit in direct lines.
   3. Install conduit through concrete beams only when the following occurs:
      a. Where shown on the structural drawings.
      b. As approved by the Engineer prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
   4. Installation of conduit in concrete that is less than 3 inches thick is prohibited.
      a. Conduit outside diameter larger than 1/3 of the slab thickness is prohibited.
      b. Space between conduits in slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.
      c. Install conduits approximately in the center of the slab so that there will be a minimum of 3/4 inch of concrete around the conduits.
   5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to insure low resistance ground continuity through the conduits. Tightening set screws with pliers is prohibited.

B. Above Furred or Suspended Ceilings and in Walls:
   1. Conduit for conductors above 600 volts:
      a. Rigid steel or rigid aluminum. Do not use aluminum in wet locations.
      b. Aluminum conduit mixed indiscriminately with other types in the same system is prohibited.
   2. Conduit for conductors 600 volts and below:
      a. Rigid steel, IMC, rigid aluminum, or EMT. Types mixed indiscriminately in the same system is prohibited.
      b. Do not use aluminum in wet locations.
   3. Align and run conduit parallel or perpendicular to the building lines.
   4. Connect recessed lighting fixtures to conduit runs with maximum six feet of flexible metal conduit extending from a junction box to the fixture.
   5. Tightening set screws with pliers is prohibited.

3.4. EXPOSED WORK INSTALLATION

A. Conduit for Conductors 600 volts and below:
   1. Rigid steel, IMC, or EMT. Types mixed indiscriminately in the system is prohibited.
   2. All exposed conduit installed within 10 feet of floor shall be rigid steel.
   3. Do not use aluminum conduit.

B. Align and run conduit parallel or perpendicular to the building lines.

C. Install horizontal runs close to the ceiling or beams and secure with conduit straps.

D. Support horizontal or vertical runs at not over eight foot intervals.

3.5. DIRECT BURIAL INSTALLATION

A. Exterior routing of Lighting Systems and Other Branch circuits (600 Volt and Less, and 5 feet from the buildings):
   1. Conduit: Thick wall PVC or high density PE, unless otherwise shown.
   2. Mark conduit at uniform intervals to show the kind of material, direct burial type, and the UL approval label.
   3. Install conduit fittings and terminations as recommended by the conduit manufacturer.
   4. Tops of conduits shall be as follows unless otherwise shown:

a. Not less than 24 inches below finished grade.
b. Not less than 30 inches below road and other paved surfaces.

5. Work with extreme care near existing ducts, conduits, cables, and other utilities to avoid damaging them.
6. Excavation for conduit bedding and back filling of trenches:
   a. Cut the trenches neatly and uniformly.
   b. Do not kink the conduits.
7. Seal conduits, including spare conduits, at building entrances and at outdoor terminations for equipment with a suitable compound that prevents the entrance of moisture and gases.

3.6. WET OR DAMP LOCATIONS

A. Unless otherwise shown, use conduits of rigid steel, IMC, or EMT with compression fittings.

B. Provide sealing fittings, to prevent passage of water vapor, where conduits pass from warm to cold locations, i.e., (refrigerated spaces, constant temperature rooms, air conditioned spaces building exterior walls, roofs) or similar spaces.

C. Unless otherwise shown, use rigid steel or IMC conduit within five feet of the exterior and below concrete building slabs in contact with soil, gravel, or vapor barriers. Cover conduit on the outside with a factory coating of .5 mm (20 mil) bonded PVC or field coat with asphaltum before installation. After installation, completely coat damaged areas of coating.

3.7. MOTORS AND VIBRATING EQUIPMENT

A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission. Provide liquid tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash down operations, inside (air stream) of HVAC units, and locations subject to seepage or dripping of oil, grease or water. Provide a green ground wire with flexible metal conduit.

3.8. EXPANSION JOINTS

A. Conduits 3 inches and larger, that are secured to the building structure on opposite sides of a building expansion joint, require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.

B. Provide conduits smaller than 3 inches with junction boxes on both sides of the expansion joint. Connect conduits to junction boxes with sufficient slack of flexible conduit to produce 5 inch vertical drop midway between the end. Flexible conduit shall have a copper green ground bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 15 inches and larger conduits are acceptable.

C. Install expansion and deflection couplings where required.

3.9. CONDUIT SUPPORTS, INSTALLATION

A. Safe working load shall not exceed 1/4 of proof test load of fastening devices.

B. Use pipe straps or individual conduit hangers for supporting individual conduits.

C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and 90 kg (200 pounds). Attach each conduit with U bolts or other approved fasteners.

D. Support conduit independently of junction boxes, pull boxes, fixtures, suspended ceiling T bars, angle supports, and similar items.

E. Fasteners and Supports in Solid Masonry and Concrete:

1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
2. Existing Construction:
    a. Steel expansion anchors not less than 1/4 inch bolt size and not less than 1 1/8 inch embedment.
    b. Power set fasteners not less than 1/4 inch diameter with depth of penetration not less than 3 inches.
    c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.

F. Hollow Masonry: Toggle bolts are permitted. Bolts supported only by plaster are not acceptable.

G. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.

H. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.

I. Chain, wire, or perforated strap shall not be used to support or fasten conduit.

J. Spring steel type supports or fasteners are prohibited for all uses except: Horizontal and vertical supports/fasteners within walls.

K. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.10. BOX INSTALLATION

A. Boxes for Concealed Conduits:

1. Mount flush.
2. Provide raised covers for boxes to suit the wall or ceiling, construction and finish.

B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.

C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap in metal covers for sheet metal boxes.

D. Outlet boxes in the same wall mounted back to back are prohibited.

E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 4 inches square by 2 1/8 inches deep, with device covers for the wall material and thickness involved.

F. Stencil or install phenolic nameplates on covers of boxes identified on riser diagrams.

END OF SECTION

SECTION 260541 - UNDERGROUND ELECTRICAL CONSTRUCTION

GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

Payment and Performance Bonds: Filed Subcontractors shall:
Provide Payment and Performance Bonds for the full value of their Subcontract.
Include the full cost of the required bond in their Bid.

Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
Comply with the Instructions to Bidders.
Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
FILED SUBCONTRACTOR'S BID FOR SECTION:
26 05 41 – Underground Electrical Construction

Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
All subcontractors to the Filed Subcontractor, whose work is:
Subject to the provisions of MGL Chap. 149, §§ 44A-J.
Valued at $10,000 or more.
The contract sum for each subcontractor required to be listed.
An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
Any sub-subcontracts listed below under Sub-sub Bid Requirements.
Comply with the applicable Mass. General Laws and the following:
Sub bidder's attention is directed to Massachusetts G.L. Chapter 149 Section 44F, as amended, which provides in part as follows.
Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing,

provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
None.	None.

1.2 Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:

1. E1.01 – Lighting Plan
2. E2.01 – Power Plan
3. E2.02 – Power Roof Top Plan
4. E3.00 – Electrical Details
5. E4.00- Electrical Notes
6. FA1.01- Fire Alarm Plan

SUMMARY OF SUB BID CONTRACT

Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:

Section 26 05 00 – Basic Method and Requirements (Electrical)
Section 26 05 21 – Cables, Low Voltage (600 Volts and Below)
Section 26 05 26 – Grounding
Section 26 05 33 – Raceway Systems
Section 26 05 41 – Underground Electrical Construction
Section 26 22 00 – Low-Voltage Transformers
Section 26 24 16 – Panelboards
Section 26 27 26 – Wiring Devices
Section 26 29 21 – Disconnects (Motor and Circuit)
Section 26 32 13 – Engine Generators
Section 26 36 23 – Automatic Transfer Switches
Section 26 51 00 – Interior Lighting
Section 28 31 64 – Fire Alarm Local Building System

Alternates: None.

1.3 DESCRIPTION

A. This section specifies the furnishing, installation and connection of raceways and wiring to form a complete underground electrical system.

B. “Metal conduit”, “rigid metal conduit”, and “rigid steel conduit" are used interchangeably in this specification and have the same meaning. PVC conduit is identified as PVC conduit.

PART 2. PRODUCTS

2.1. UNDERGROUND RACEWAYS

A. Number and sizes shall be as shown on drawings.

B. Underground Raceways (direct burial):

1. Plastic duct:
   a. Schedule 40 PVC or HDPE.
   b. Duct shall be suitable for use with 75 degree C rated conductors.
   c. Shall be listed for electrical construction.
2. Rigid metal conduit, PVC-coated: UL6 and NEMA RN1 galvanized rigid steel, threaded type, coated with PVC sheath bonded to the galvanized exterior surface, nominal 0.040 inch thick.

2.2. WARNING TAPE

A. Standard 4-mil polyethylene 3 inch wide tape, detectable type, red with black letters, imprinted with “CAUTION BURIED ELECTRIC CABLE BELOW”.

PART 3. EXECUTION

3.1. TRENCHING

A. Work with extreme care near existing ducts, conduits, cables, and other utilities to avoid damaging them.

B. Cut the trenches neatly and uniformly.

C. Conduits to be installed under existing paved areas and roads that are not to be disturbed shall be jacked into place. Conduits beneath roadways and parking areas shall be PVC-coated rigid metal. Conduits beneath landscaped areas may be PVC.

3.2. DUCT INSTALLATION

A. Direct Burial Raceways:

1. Join and terminate ducts and conduits with fittings recommended by conduit manufacturer and listed for use.

2. Tops of ducts and conduits shall be:
   a. Not less than 24 inches below finished grade.
   b. Not less than 30 inches below roads and other paved surfaces.
3. Do not kink the ducts or conduits.

B. Spare Ducts and Conduits: Where spare ducts are shown, they shall have a nylon pull rope installed. They shall be capped at each end and labeled as to location of the other end.

C. Duct and Conduit Cleaning:

1. Upon completion of the duct bank installation or installation of direct buried ducts, a standard flexible mandrel shall be pulled through each duct to loosen particles of earth, sand, or foreign material left in the line. The mandrel shall be not less than 12 inches long, and shall have a diameter not less than 1/2 inch less than the inside diameter of the duct. A brush with stiff bristles shall then be pulled through each duct to remove the loosened particles. The diameter of the brush shall be the same as, or slightly larger than the diameter of the duct.
2. All obstructed, damaged or crushed ducts shall be replaced.

END OF SECTION

SECTION 26 22 00 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
   1. Provide Payment and Performance Bonds for the full value of their Subcontract.
   2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
   1. Comply with the Instructions to Bidders.
   2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
   3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
   4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
      FILED SUBCONTRACTOR'S BID FOR SECTION:
      26 22 00- Low-Voltage Transformers

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
   1. All subcontractors to the Filed Subcontractor, whose work is:
      a. Subject to the provisions of MGL Chap. 149, §§ 44A-J.
      b. Valued at $10,000 or more.
   2. The contract sum for each subcontractor required to be listed.
      a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
   3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
   4. Comply with the applicable Mass. General Laws and the following:
      a. Sub bidder's attention is directed to Massachusetts G.L. Chapter 149 Section 44F, as amended, which provides in part as follows.
      b. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such

listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None.	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. E1.01 – Lighting Plan
2. E2.01 – Power Plan
3. E2.02 – Power Roof Top Plan
4. E3.00 – Electrical Details
5. E4.00- Electrical Notes
6. FA1.01- Fire Alarm Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 26 05 00 – Basic Method and Requirements (Electrical)
2. Section 26 05 21 – Cables, Low Voltage (600 Volts and Below)
3. Section 26 05 26 – Grounding
4. Section 26 05 33 – Raceway Systems
5. Section 26 05 41 – Underground Electrical Construction
6. Section 26 22 00 – Low-Voltage Transformers
7. Section 26 24 16 – Panelboards
8. Section 26 27 26 – Wiring Devices
9. Section 26 29 21 – Disconnects (Motor and Circuit)
10. Section 26 32 13 – Engine Generators
11. Section 26 36 23 – Automatic Transfer Switches
12. Section 26 51 00 – Interior Lighting
13. Section 28 31 64 – Fire Alarm Local Building System

B. Alternates: None.

1.3. DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of low-voltage dry-type general-purpose transformers, indicated as transformers in this section.

1.4. Related work

A. Section 26 05 00, requirements for electrical installations: requirements that apply to all sections of division 26.

B. Section 26 05 26, grounding and bonding for electrical systems: requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

C. Section 26 05 33, raceway and boxes for electrical systems: conduit.

1.5. Quality assurance

A. Refer to paragraph, qualifications (products and services), in section 26 05 00, requirements for electrical installations

1.6. Submittals

A. Submit the following in accordance with section 26 05 00, requirements for electrical installations.

1. SHOP DRAWINGS:

A. Submit sufficient information to demonstrate compliance with drawings and specifications.

B. include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, temperature rise, wiring and connection diagrams, plan, front, side, and rear elevations, accessories, and device nameplate data.

1.7. APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. publications are referenced in the text by designation only.

B. International Code Council (ICC)

IBC-15 .....International Building Code

C. National Fire Protection Association (NFPA):

70-14.....National Electrical Code (NEC)

D. National Electrical Manufacturers Association (NEMA):

TR 1-13 .....Transformers, Step Voltage Regulators and Reactors

ST 20-14 .....Dry Type Transformers for General Applications

E. Underwriters Laboratories, Inc. (UL):

UL 506-08.....Standard for Specialty Transformers

UL 1561-11.....Dry-Type General Purpose and Power Transformers

F. United States Department of Energy

10 CFR Part 431.....Energy Efficiency Program for Certain Commercial and Industrial Equipment

PART 2. PRODUCTS

TRANSFORMERS

A. Unless otherwise specified, transformers shall be in accordance with NEMA, NEC, UL and as shown on the drawings.

B. Transformers shall have the following features:

1. Self-cooled by natural convection, isolating windings, outdoor dry-type. Autotransformers will not be accepted, except as specifically allowed for buck-boost applications.
2. Rating and winding connections shall be as shown on the drawings.
3. Ratings shown on the drawings are for continuous duty without the use of cooling fans.
4. Copper windings.
5. Insulation systems:
    a. Transformers 30 kVA and larger: UL rated 220 °C (428 °F) system with an average maximum rise by resistance of 150 °C (302 °F) in a maximum ambient of 40 °C (104 °F).
    b. Transformers below 30 kVA: Same as for 30 kVA and larger or UL rated 185 °C (365 °F) system with an average maximum rise by resistance of 115 °C (239 °F) in a maximum ambient of 40 °C (104 °F).
6. Core and coil assemblies:
    a. Rigidly braced to withstand the stresses caused by short-circuit currents and rough handling during shipment.
    b. Cores shall be grain-oriented, non-aging, and silicon steel.
    c. Coils shall be continuous windings without splices except for taps.
    d. Coil loss and core loss shall be minimized for efficient operation.
    e. Primary and secondary tap connections shall be brazed or pressure type.
    f. Coil windings shall have end filters or tie-downs for maximum strength.
7. Average audible sound levels shall comply with NEMA.
8. If not shown on drawings, nominal impedance shall be as permitted by NEMA.

9. Single phase transformers rated 15 kVA through 25 kVA shall have two 5% full capacity taps below normal rated primary voltage. All transformers rated 30 kVA and larger shall have two 2.5% full capacity taps above, and four 2.5% full capacity taps below normal rated primary voltage.
10. Core assemblies shall be grounded to their enclosures with adequate flexible ground straps.
11. Enclosures:
    a. Comprised of not less than code gauge steel.
    b. Outdoor enclosures shall be NEMA 3R.
    c. Temperature rise at hottest spot shall conform to NEMA Standards, and shall not bake and peel off the enclosure paint after the transformer has been placed in service.
    d. Ventilation openings shall prevent accidental access to live components.
    e. The enclosure at the factory shall be thoroughly cleaned and painted with manufacturer's prime coat and standard finish.
12. Standard NEMA features and accessories, including ground pad, lifting provisions, and nameplate with the wiring diagram and sound level indicated.
13. Dimensions and configurations shall conform to the spaces designated for their installations.
14. Transformers shall meet the energy conservation standards for transformers per the United States Department of Energy's 10 CFR Part 431.

PART 3. **EXECUTION**

3.1 INSTALLATION

A. Installation of transformers shall be in accordance with the NEC, as recommended by the equipment manufacturer and as shown on the drawings.

B. Anchor transformers with rustproof bolts, nuts, and washers, in accordance with manufacturer's instructions, and as shown on drawings.

C. Exterior Location: Wall mount transformer.

E. Install transformers with manufacturer's recommended clearance from wall and adjacent equipment for air circulation.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform tests in accordance with the manufacturer's recommendations. In addition, include the following:

1. Visual Inspection and Tests:
    a. Compare equipment nameplate data with specifications and approved shop drawings.
    b. Inspect physical and mechanical condition.
    c. Inspect all field-installed bolted electrical connections, using the calibrated torque-wrench method to verify tightness of accessible bolted electrical connections.
    d. Perform specific inspections and mechanical tests as recommended by manufacturer.
    e. Verify correct equipment grounding.
    f. Verify proper secondary phase-to-phase and phase-to-neutral voltage after energization and prior to connection to loads.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks, settings, and tests, the contractor shall demonstrate that the transformers are in good operating condition, and properly performing the intended function.

END OF SECTION

SECTION 26 24 16 – PANELBOARDS

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
   1. Provide Payment and Performance Bonds for the full value of their Subcontract.
   2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
   1. Comply with the Instructions to Bidders.
   2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
   3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
   4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
      FILED SUBCONTRACTOR'S BID FOR SECTION:
      26 24 16- Panelboards

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
   1. All subcontractors to the Filed Subcontractor, whose work is:
      a. Subject to the provisions of MGL Chap. 149, §§ 44A-J.
      b. Valued at $10,000 or more.
   2. The contract sum for each subcontractor required to be listed.
      a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
   3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
   4. Comply with the applicable Mass. General Laws and the following:
      a. Sub bidder's attention is directed to Massachusetts G.L. Chapter 149 Section 44F, as amended, which provides in part as follows.
      b. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof

and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None.	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. E1.01 – Lighting Plan
2. E2.01 – Power Plan
3. E2.02 – Power Roof Top Plan
4. E3.00 – Electrical Details
5. E4.00- Electrical Notes
6. FA1.01- Fire Alarm Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 26 05 00 – Basic Method and Requirements (Electrical)
2. Section 26 05 21 – Cables, Low Voltage (600 Volts and Below)
3. Section 26 05 26 – Grounding
4. Section 26 05 33 – Raceway Systems
5. Section 26 05 41 – Underground Electrical Construction
6. Section 26 22 00 – Low-Voltage Transformers
7. Section 26 24 16 – Panelboards
8. Section 26 27 26 – Wiring Devices
9. Section 26 29 21 – Disconnects (Motor and Circuit)
10. Section 26 32 13 – Engine Generators
11. Section 26 36 23 – Automatic Transfer Switches
12. Section 26 51 00 – Interior Lighting
13. Section 28 31 64 – Fire Alarm Local Building System

B. Alternates: None.

1.3. DESCRIPTION

A. This section includes the furnishing, installation, and connection of panelboards.

1.4. RELATED WORK

A. Section 26 05 00, BASIC METHODS AND REQUIREMENTS (ELECTRICAL).

B. Section 26 05 26, GROUNDING.

1.5. SUMBITTALS.

A. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.

1.6. APPLICABLE PUBLICATIONS

The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.

A. Underwriters Laboratories, Inc. (UL):

50 Cabinet and Boxes, Electrical

. 67 Panelboards

. 489 Molded Case Circuit Breakers and Circuit Breaker Enclosures

B. National Fire Protection Association (NFPA):

70 National Electrical Code (NEC)

C. National Electrical Manufacturers Association (NEMA):

PB 1 Panelboards

AB 1 Molded Case Circuit Breakers

PART 2. PRODUCTS

2.1. PANELBOARDS

A. Panelboards shall be in accordance with UL, NEMA, NEC, and as shown on the drawings.

B. Provide standard manufactured products. All components of panelboards shall be the product and assembly of the same manufacturer. All similar units of all panelboards to be of the same manufacturer.

C. All panels shall be dead front safety type. Arrange sections for easy removal without disturbing other sections.

D. All panelboards shall be completely factory assembled with molded case circuit breakers.

E. Panels shall have main breaker or main lugs, bus size, voltage, and phase as shown on the drawings. Panels may be top or bottom feed. Panels shall be flush when installed on finished wall surfaces. Panels shall be surface mount when installed in unfinished rooms.

F. Panelboards shall have the following features:

1. Non-reduced size copper or aluminum bus bars, and connection straps bolted together and rigidly supported on molded insulators. Bus bar taps for panels with single pole branches shall be arranged for sequence phasing of branch circuit devices.
2. Full size neutral bar, mounted on insulated supports.
3. Ground bar with sufficient terminals for all grounding wires.
4. Buses braced for the available short circuit current as indicated on the drawings. If no ratings are shown on the drawings the ratings shall be not less than 10,000 amperes symmetrical for 120/128 volt and 120/240 volt panelboards, and 14,000 amperes symmetrical for 277/480 volt panelboards.
5. All breakers and phase bus connections shall be arranged so that it will be possible to substitute a 2 pole breaker for two single pole breakers, and a 3 pole breaker for three single pole breakers, when trip is 30 amps or less and frame size is 100 amperes or less, without having to drill and tap the main bus bars at bus straps.
6. Design interior so that protective devices can be replaced without removing adjacent units, main bus connectors, and without drilling or tapping. Panel phase bus connections to protective devices shall not be riveted to the panel bus and shall be field removable by means of a screw driver.
7. Where designated on panel schedule as "space" or “spare”, include all necessary bussing, device support and connections. Provide blank cover for each space.
8. In two section panelboards, the main bus in each section shall be full size. The first section shall be furnished with subfeed lugs on the line side with cable connections to the second section. Panelboard sections with tapped bus or crossover bus shall not be accepted.

2.2. CABINETS AND TRIMS

A. Cabinets:
1. Panelboard enclosures shall be NEMA 3R rated.

2. Provide galvanized steel cabinets to house panelboards. Cabinets for distribution panels may be factory primed and suitably treated with a corrosion resisting paint finish meeting UL standard for outdoor applications.
3. Cabinet enclosure shall not have ventilating openings.
4. Back and sides shall be of one piece formed steel. Cabinets for distribution panels may be of formed sheet steel with end and side panels welded, riveted, or bolted as required.
5. Provide minimum of four interior mounted studs and necessary hardware for "in" and "out" adjustment of panel interior.
6. Gutter size in panel boxes, on all sides, shall be in accordance with the NEC. Cabinets containing through feeders shall have the gutters space increased by the amount required for auxiliary gutters in the NEC.

B. Trims:
1. Fabricate trim of sheet steel consisting of frame with door attached by concealed hinges. Provide flush or surface trim as shown on the drawings.
2. Surface trim shall have the same width and height as the box.
3. Flush or surface trims shall not have ventilating openings.
4. Secure trims to back boxes by indicating trim clamps or screws.

C. Doors:
1. Provide doors with flush type latch and manufacturer's standard lock. Doors over 48 inches in height shall have a vault handle and a three point catch, arranged to fasten door at top, bottom, and center.
2. In making switching devices accessible, doors shall not uncover any live parts.
3. Provide concealed, butt hinges welded to the doors and trims.
4. Provide keyed alike system for all panelboards. In existing buildings where new panels are installed, provide keyed alike locks as directed by the Engineer.
5. Provide a directory card, metal holder, and transparent cover. Permanently mount holders on inside of doors.

D. Painting:
1. Thoroughly clean and paint trims and doors at the factory with primer and manufacturer's standard finish.

2.3. MOLDED CASE CIRCUIT BREAKERS FOR PANELBOARDS

A. Breakers shall be UL listed and labeled, in accordance with the NEC, as shown on the drawings, and as specified.

B. Circuit breakers in panelboards shall be bolt on type on phase bus bar or branch circuit bar. Loadcenter circuit breakers may be plug on type.

1. Molded case circuit breakers for lighting and appliance branch circuit panelboards shall have minimum interrupting rating as indicated but not less than:

a. 120/208 Volt Panelboard: 22,000 amperes symmetrical.
b. 120/240 Volt Panelboard: 10,000 amperes symmetrical.
c. 277/480 Volt Panelboard: 14,000 amperes symmetrical.

C. Molded case circuit breakers shall have automatic, trip free, non adjustable, inverse time, and instantaneous magnetic trips for 100 ampere frame or less. Magnetic trip shall be adjustable from 3X to 10X for breakers with 600 ampere frames and higher. Factory setting shall be HI, unless otherwise noted.

D. Breaker features shall be as follows:

1. A rugged, integral housing of molded insulating material.
2. Silver alloy contacts.
3. Arc quenchers and phase barriers for each pole.
4. Quick make, quick break, operating mechanisms.
5. A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.
6. Electrically and mechanically trip free.
7. An operating handle which indicates ON, TRIPPED, and OFF positions.
8. Line connections shall be bolted for 480 volt panels, bolted or plug-on for 208 volt panels.
9. Interrupting rating shall not be less than the maximum short circuit current available at the line terminals as indicated on the drawings.
10. An overload on one pole of a multipole breaker shall automatically cause all the poles of the breaker to open.
11. For circuit breakers being added to existing panelboards, coordinate the breaker type with existing panelboards. Modify the panel directory.

PART 3. EXECUTION

3.1. INSTALLATION

A. Installation shall be in accordance with NEC, as shown on the drawings, and as specified.

B. Locate panelboards so that the present and future conduits can be conveniently connected. Coordinate the sizes of cabinets with designated closet space.

C. Install a typewritten directory of circuits in each panelboard after wiring is complete. Schedule shall be typed on the panel directory cards. Include the room numbers and items served on the cards. Descriptions shall be in conformance with NFPA 70 requirements.

D. Mount the panelboard so that maximum height of circuit breaker above finished floor shall not exceed 78 inches. For panelboards which are too high, mount panelboard so that the bottom of the cabinets will not be less than 6 inches above the finished floor.

E. For panelboards located in areas accessible to the public, paint the exposed surfaces of the trims, doors, and boxes with finishes to match surrounding surfaces after the panelboards have been installed.

F. Circuit numbers indicated on the drawings are shown for the purpose of clarifying the grouping of outlets. The actual number assigned to the circuit in the panelboard shall suit the bussing and branch circuiting to the panel.

END OF SECTION

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
   1. Provide Payment and Performance Bonds for the full value of their Subcontract.
   2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
   1. Comply with the Instructions to Bidders.
   2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
   3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
   4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
      FILED SUBCONTRACTOR'S BID FOR SECTION:
      26 27 26 – Wiring Devices

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
   1. All subcontractors to the Filed Subcontractor, whose work is:
      a. Subject to the provisions of MGL Chap. 149, §§ 44A-J.
      b. Valued at $10,000 or more.
   2. The contract sum for each subcontractor required to be listed.
      a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
   3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
   4. Comply with the applicable Mass. General Laws and the following:
      a. Sub bidder's attention is directed to Massachusetts G.L. Chapter 149 Section 44F, as amended, which provides in part as follows.
      b. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof

and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None**.**	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. E1.01 – Lighting Plan
2. E2.01 – Power Plan
3. E2.02 – Power Roof Top Plan
4. E3.00 – Electrical Details
5. E4.00- Electrical Notes
6. FA1.01- Fire Alarm Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 26 05 00 – Basic Method and Requirements (Electrical)
2. Section 26 05 21 – Cables, Low Voltage (600 Volts and Below)
3. Section 26 05 26 – Grounding
4. Section 26 05 33 – Raceway Systems
5. Section 26 05 41 – Underground Electrical Construction
6. Section 26 22 00 – Low-Voltage Transformers
7. Section 26 24 16 – Panelboards
8. Section 26 27 26 – Wiring Devices
9. Section 26 29 21 – Disconnects (Motor and Circuit)
10. Section 26 32 13 – Engine Generators
11. Section 26 36 23 – Automatic Transfer Switches
12. Section 26 51 00 – Interior Lighting
13. Section 28 31 64 – Fire Alarm Local Building System

B. Alternates: None.

1.3. DESCRIPTION

This section includes the furnishing, installation, and connection of wiring devices.

1.4. RELATED WORK

A. Section 26 05 00, BASIC METHODS AND REQUIREMENTS (ELECTRICAL).

B. Section 26 05 33, RACEWAY SYSTEMS.

C. Section 26 05 21, CABLES, LOW VOLTAGE (600 VOLTS AND BELOW).

D. Section 26 05 26, GROUNDING.

1.5. APPLICABLE PUBLICATIONS

The publications listed below form a part of this specification to the extent referenced. The issue in effect listed below (including amendments, addenda, revisions, supplements, and errata) on the date of Invitation for Bids shall be applicable. The publications are referenced in the text by designation only.

A. National Fire Protection Association (NFPA):

70 National Electrical Code (NEC)

B. National Electrical Manufacturers Association (NEMA):

WD1 General Requirements for Wiring Devices

WD6 Wiring Devices – Dimensional Requirements

C. Underwriter's Laboratories, Inc. (UL):

5 Safety; Surface Metal Raceways and Fittings

20 Safety; General-Use Snap Switches

231 Safety; Power Outlets

467 Safety; Grounding and Bonding Equipment

498 Safety; Attachment Plugs and Receptacles

943 Safety; Ground Fault Circuit Interrupters

PART 2. PRODUCTS

2.1. RECEPTACLES

A. General: All receptacles shall be specification grade and conform to NEMA WD1.

1. Mounting straps shall be plated steel, with break-off plaster ears and shall include a self-grounding feature. Terminal screws shall be brass, brass plated or a copper alloy metal.
2. Receptacles shall have provisions for back wiring with separate metal clamp type terminals (four min.) and side wiring from four captively held binding screws.

B. Standard duplex receptacles shall be single phase, 15 Ampere, 120 volts, 2 pole, 3 wire, and conform to the NEMA 5 20R configuration. The duplex type shall have break off feature for two circuit operation. The ungrounded pole of each receptacle shall be provided with a separate terminal. Other outlet configurations shall be as shown on the drawings.

1. Bodies shall be ivory unless noted otherwise on the drawings.
2. Switched duplex receptacles shall be wired so that only the top receptacle is switched. The remaining receptacle shall be un-switched.
3. Ground Fault Interrupter Duplex Receptacles: Shall be an integral unit suitable for mounting in a standard outlet box.
    a. Ground fault interrupter, shall be specification grade and consist of a differential current transformer, solid state sensing circuitry and a circuit interrupter switch. It shall be rated for operation on a 60 Hz, 120 volt, 20 ampere branch circuit. Device shall have nominal sensitivity to ground leakage current of five milliamperes and shall function to interrupt the current supply for any value of ground leakage current above five milliamperes on the load side of the device. Device shall have a minimum nominal tripping time of 1/30th of a second. Devices shall meet UL 943.
4. Arc Fault Interrupter Receptacles shall be UL listed and installed per requirements of local enforcement of NFPA 70.
5. Isolated Ground Type Duplex Receptacles:
    a. Bodies shall be orange in color.
    b. Shall be specification grade and UL listed as “Isolated Ground”.

C. Receptacles 20, 30 and 50 Ampere, 250 Volt: Devices shall meet UL 231.

D. Weatherproof Receptacles: Shall consist of a duplex receptacle, mounted in box with a gasketed, weatherproof, cast metal cover plate and cap over each receptacle opening. The cap shall be permanently attached to the cover plate by a spring hinged flap. The weatherproof integrity shall not be affected when heavy duty specification or hospital grade attachment plug caps are inserted. Cover plates on outlet boxes mounted flush in the wall shall be gasketed to the wall in a watertight manner.

2.2. TOGGLE SWITCHES AND DIMMERS

A. Toggle switches shall be totally enclosed tumbler type with bodies of phenolic compound.

B. Toggle handles shall be the ivory unless shown otherwise on the drawings.

1. Switches installed in hazardous areas shall be explosion proof type in accordance with the NEC and as shown on the drawings.
2. Shall be single unit toggle, butt contact, quiet AC type, heavy duty general-purpose use with an integral self-grounding mounting strap with break-off plasters ears and provisions for back wiring with separate metal wiring clamps and side wiring with captively held binding screws.
3. Ratings:
   a. 120 volt circuits: 20 amperes at 120-277 volts AC.
   b. 277 volt circuits: 20 amperes at 120-277 volts AC.
4. The switches shall be mounted on the striker plate side of doors, unless otherwise shown.
5. Incorporate barriers between switches with multigang outlet boxes where required by the NEC.
6. All toggle switches shall be of the same manufacturer.

2.3. WALL PLATES

A. Wall plates for switches and receptacles in non-residential applications shall be type 302 stainless steel unless noted otherwise on the drawings. Oversize plates will not be acceptable.

B. Standard NEMA design, so that products of different manufacturers will be interchangeable. Dimensions for openings in wall plates shall be accordance with NEMA WD1 and compatible with devices.

C. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.

D. Each receptacle cover plate shall have a mechanically printed laminated label affixed that identifies the source panel and branch circuit information of the circuit that supplies the outlet. The minimum size print shall be 3/16”.

PART 3. EXECUTION

3.1. INSTALLATION

A. Installation shall be in accordance with the NEC, and as shown as on the drawings.

B. Ground terminal of each receptacle shall be bonded to the outlet box with an approved green bonding jumper.

END OF SECTION

SECTION 26 29 21 - DISCONNECTS (MOTOR AND CIRCUIT)

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
   1. Provide Payment and Performance Bonds for the full value of their Subcontract.
   2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
   1. Comply with the Instructions to Bidders.
   2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
   3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
   4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
      FILED SUBCONTRACTOR'S BID FOR SECTION:
      26 29 21 – Disconnects (Motor and Circuit)

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
   1. All subcontractors to the Filed Subcontractor, whose work is:
      a. Subject to the provisions of MGL Chap. 149, §§ 44A-J.
      b. Valued at $10,000 or more.
   2. The contract sum for each subcontractor required to be listed.
      a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
   3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
   4. Comply with the applicable Mass. General Laws and the following:
      a. Sub bidder's attention is directed to Massachusetts G.L. Chapter 149 Section 44F, as amended, which provides in part as follows.
      b. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof

and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None**.**	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. E1.01 – Lighting Plan
2. E2.01 – Power Plan
3. E2.02 – Power Roof Top Plan
4. E3.00 – Electrical Details
5. E4.00- Electrical Notes
6. FA1.01- Fire Alarm Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 26 05 00 – Basic Method and Requirements (Electrical)
2. Section 26 05 21 – Cables, Low Voltage (600 Volts and Below)
3. Section 26 05 26 – Grounding
4. Section 26 05 33 – Raceway Systems
5. Section 26 05 41 – Underground Electrical Construction
6. Section 26 22 00 – Low-Voltage Transformers
7. Section 26 24 16 – Panelboards
8. Section 26 27 26 – Wiring Devices
9. Section 26 29 21 – Disconnects (Motor and Circuit)
10. Section 26 32 13 – Engine Generators
11. Section 26 36 23 – Automatic Transfer Switches
12. Section 26 51 00 – Interior Lighting
13. Section 28 31 64 – Fire Alarm Local Building System

B. Alternates: None.

1.3. DESCRIPTION

A. This section specifies low voltage disconnect switches.

1.4. RELATED WORK

A. Section 26 05 00, BASIC METHODS AND REQUIREMENTS (ELECTRICAL).

B. Section 26 05 26, GROUNDING.

1.5. SUBMITTALS

A. Include sufficient information, clearly presented, to determine compliance with drawings and specifications. Include information on electrical ratings, mounting, material, and enclosure types.

1.6. APPLICABLE PUBLICATIONS

The publication listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

A. Underwriters Laboratories, Inc. (UL):

98 Enclosed and Dead-Front Switches

198C High Interrupting-Capacity Fuses, Current Limiting Type

198E Class R Fuses

977 Fused Power-Circuit Devices

B. National Fire Protection Association (NFPA):

70 National Electrical Code (NEC)

C. National Electrical Manufacturers Association (NEMA):

KS l Enclosed and Miscellaneous Distribution Equipment

Switches (600 Volts Maximum)

PART 2. PRODUCTS

2.1. LOW VOLTAGE FUSIBLE SWITCHES RATED 600 AMPERES AND LESS

A. Quick-make, quick-break type in accordance with UL98, NEMA KS 1 and NEC.

B. Minimum duty rating, NEMA classification General Duty (GD) for 240 volts and NEMA classification Heavy Duty (HD) for 277/480 volts.

C. Shall have the following features:

1. Switch mechanism shall be the quick-make, quick-break type.
2. Copper blades, visible in the OFF position.
3. An arc chute for each pole.
4. External operating handle shall indicate ON and OFF position and shall have lock open padlocking provisions.
5. Mechanical interlock shall permit opening of the door only when the switch is in the OFF position, defeatable by a special tool to permit inspection.
6. Fuse mounting for the size and type of fuses specified. Furnish switches completely fused. Furnish a complete set of spare fuses for each switch being installed. Provide additional sets of spare fuses to constitute not less than two complete sets for the type, size, and rating of each set installed. Deliver the fuses to the Engineer prior to the final inspection.
7. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
8. Ground Lugs: One for each ground conductor.
9. Enclosures:
   a. Shall be the NEMA 3R.

2.2. LOW VOLTAGE UNFUSED SWITCHES RATED 600 AMPERES AND LESS

A. Shall be the same as Low Voltage Fusible Switches rated 600 amperes and less, except it shall not accept fuses.

2.3. MOTOR RATED TOGGLE SWITCH

A. Motor rated toggle switch shall be single pole, 115 volts and shall include overload protection and pilot light to indicate the "on" or "running" condition of motor.

B. Enclosures shall be most suitable for the environmental conditions where the switches are being installed.

PART 3. EXECUTION

3.1. INSTALLATION

A. Installation shall be in accordance with the NEC and as shown on the drawings.

B. Contractor shall confirm location of equipment to be served by disconnect with equipment installer prior to installation of disconnect and associated wiring. Contractor shall confirm rating required by equipment to be served prior to installation of disconnect.

END OF SECTION

SECTION 26 32 13 - ENGINE GENERATORS

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
   1. Provide Payment and Performance Bonds for the full value of their Subcontract.
   2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
   1. Comply with the Instructions to Bidders.
   2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
   3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
   4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
      FILED SUBCONTRACTOR'S BID FOR SECTION:
      26 32 13 – Engine Generators

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
   1. All subcontractors to the Filed Subcontractor, whose work is:
      a. Subject to the provisions of MGL Chap. 149, §§ 44A-J.
      b. Valued at $10,000 or more.
   2. The contract sum for each subcontractor required to be listed.
      a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
   3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
   4. Comply with the applicable Mass. General Laws and the following:
      a. Sub bidder's attention is directed to Massachusetts G.L. Chapter 149 Section 44F, as amended, which provides in part as follows.
      b. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof

and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None**.**	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. E1.01 – Lighting Plan
2. E2.01 – Power Plan
3. E2.02 – Power Roof Top Plan
4. E3.00 – Electrical Details
5. E4.00- Electrical Notes
6. FA1.01- Fire Alarm Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 26 05 00 – Basic Method and Requirements (Electrical)
2. Section 26 05 21 – Cables, Low Voltage (600 Volts and Below)
3. Section 26 05 26 – Grounding
4. Section 26 05 33 – Raceway Systems
5. Section 26 05 41 – Underground Electrical Construction
6. Section 26 22 00 – Low-Voltage Transformers
7. Section 26 24 16 – Panelboards
8. Section 26 27 26 – Wiring Devices
9. Section 26 29 21 – Disconnects (Motor and Circuit)
10. Section 26 32 13 – Engine Generators
11. Section 26 36 23 – Automatic Transfer Switches
12. Section 26 51 00 – Interior Lighting
13. Section 28 31 64 – Fire Alarm Local Building System

B. Alternates: None.

1.3. DESCRIPTION

A. This section specifies the furnishing, complete installation, connection and testing of the engine generator system. This includes: air filtration, starting system, generator controls, instrumentation, lubrication, cooling system, and exhaust system.

B. The engine generator system shall be fully automatic and shall constitute a unified and coordinated system ready for operation.

C. The engine generator system shall include, but not be limited to the following:

1. Diesel Engine.
2. Lubrication Oil System.
3. Fuel Oil System.
4. Cooling System.
5. Radiator and Enclosure.
6. Intake and Exhaust Air Systems.
7. Starting System.
8. Generator.
9. Controls, Supervision and Distribution.
10. Outdoor Generator Enclosure.
11. Spare Parts.

1.4. RELATED WORK – NOT USED

1.5. QUALITY ASSURANCE

A. The supplier of the engine generator set shall be responsible for satisfactory total operation of the system and its certification. This supplier shall have had experience with three or more installations of systems of comparable size and complexity in regards to coordinating, engineering, testing and supervising. Each of these installations shall have been in successful operation for three or more years.

B. Factory authorized representative shall be capable of providing emergency maintenance and repairs at the project site within 4 hours maximum of notification.

C. Engine generator and auxiliary components shall be supplied from a single manufacturer.

D. Noise level developed by the generator set shall be as herein specified.

1.6. SUBMITTALS

A. NOT USED

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Data shall be submitted in the following form:
   a. Technical data sheets (TDS): These include published performance, rating and derating curves, published ratings, catalog cuts, pictures, manufacturer's specifications, material composition, and gauge thickness.
   b. Description of operation (DO): Manufacturer's literatures and, if suitable, diagrams.
   c. Shop Drawings (SD): Scaled drawings showing plan views, side views, elevations and cross sections.
   d. Diagrams (DGM): These include control system diagrams, elementary diagrams, control sequence diagrams or table, wiring diagrams, interconnections diagrams (between local control cubicles, remote annunciator panels, remote derangement panels, remote monitoring panels, remote exercising panel and underground fuel storage tanks), wireless connection diagrams, illustrative diagrams, flow diagrams, and other like items.

C. Manuals:

Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals of the engine generator set and auxiliaries including technical data sheets, wiring diagrams, and information, such as telephone number, fax number, and web sites, for ordering replacement parts.

1.7. STORAGE AND HANDLING

Equipment shall withstand the mechanical stresses caused by rough handling during shipment in addition to the electrical and mechanical stresses, which occur during operation of the system. Protect radiator core with wood sheet.

1.8. JOB CONDITIONS

A. Shall conform to the arrangements and details shown on the drawings. The dimensions, enclosures and arrangements of the engine-generator set shall permit the operating personnel to safely and conveniently operate and maintain the system in the space designated for installation.

B. Unless specified otherwise, each component of the engine-generator system shall be capable of operating as specified herein at 1000 feet above sea level in a ventilated room which will have average ambient air temperatures ranging from a minimum of 0 degrees F in winter to maximum of 100 degrees F in summer.

1.9. APPLICABLE PUBLICATIONS

Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

A. American National Standards Institute (ANSI):

C37.50	Low-Voltage AC Power Circuit Breakers used In Enclosures-Test Procedures

B. American Society of Testing Materials (ASTM):

A53/A53M	Standard Specification for Pipe, Steel, Black, and Hot–Dipped, Zinc Coated Welded and Seamless.
B88	Specification for Seamless Copper Water Tube
B88M	Specification for Seamless Copper water Tube (Metric)

C. Institute of Electrical and Electronic Engineers (IEEE):

C37.13	Low Voltage AC Power Circuit Breakers Used In Enclosures
C37.90.1	Surge Withstand Capability (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus

D. National Electrical Manufacturers Association (NEMA):

AB 1	Molded Case Circuit Breakers and Molded Case Switches and Circuit Breaker Enclosures
ICS 6	Industrial Control and Systems: Enclosures
ICS 4	Terminal Blocks,
MG 1	Motor and Generators

MG 2 Safety Standard and Guide for Selection, Installation and use of Electric Motors and Generators

PB 2 Dead Front Distribution Switchboards

SG 3 Low Voltage Power Circuit Breakers-Power Switching Equipment

SG 5 Power Switchgear Assemblies

250 Enclosures for Electrical Equipment (1000 Volts Maximum)

E. National Electrical Testing Association (NETA):

ATS Electrical Power Distribution Equipment and Systems

F. National Fire Protection Association (NFPA):

30 Flammable and Combustible Liquids Code.

37 Installations and Use of Stationary Combustion Engine and Gas Turbines

70 National Electrical Code (NEC)

110 Standard for Emergency and Standby Power Systems.

G. Underwriters Laboratories, Inc. (UL):

50 Enclosures for Electrical Equipment

142 Steel Aboveground Tanks for Flammable and Combustible liquids

2085 Insulated Aboveground Tanks for Flammable and Combustible Liquids

2200 Stationery Engine Generator Assemblies

1236 Battery Charges for Charging Engine-Starter Batteries

467 Grounding and Bonding Equipment.

489 Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures

508 Industrial Control Equipment

891 Dead-Front Switchboards

PART 2. PRODUCTS

2.1. ENGINE GENERATOR SET

A. The engine generator system shall be in accordance with NFPA, UL, NEMA and ANSI, and as specified and as shown on the drawings.

B. Provide a factory-assembled, wired, (except for the field connections), complete, fully automatic engine-generator system.

C. Published Rating:

1. Shall be not less than 200KW/KVA Standby at 208/120volts, 3-phase, 4-wire, 60 Hz.
2. Shall be capable of operating continuously for six consecutive hours within any 24-hour period of operation at 110 percent of its specified rating without damage.

D. Assemble, connect and wire the equipment at the factory so that only the external connections need to be made at the construction site.

E. Unit shall be factory painted with manufacturer's primer and standard finishes.

F. Coordinate the components of the system and their arrangements, electrically and mechanically.

G. Connections between components of the system shall conform to the recommendations of the manufacturer of the engine-generator set.

H. Couplings, shafts, and other moving parts shall be enclosed and guarded. Guards shall be metal, ruggedly constructed, rigidly fastened and readily removable for convenient servicing of the equipment without disassembling any pipes and fittings.

I. Generator set and cooling system shall be furnished with extended life antifreeze solution to protect the system from freezing at all times.

J. Generator set shall have the following features:

1. Factory-mounted on a common, rigid, welded, structural steel base.
2. The maximum engine-generator set vibration in the horizontal, vertical, and axial directions shall be limited to 0.15mm with an overall velocity limit of 24 mm/sec RMS, for all speeds.
3. The isolators shall be constrained with restraints capable of withstanding static forces in any direction equal to twice the weight of the supported equipment.
4. Automatic start, accelerate to the specified RPM and deliver the specified KW/KVA output at 60 Hz within 10 seconds after a single pole contact closes in a remote device.
5. Recover rapidly from instantaneous changes between no load and the specified KW/KVA rating, and the reverse changes of load, without damage.
6. Shall be capable of operating satisfactorily as specified for not less than 10,000 hours between major overhauls.
7. Engine-generator set shall be statically and dynamically balanced at the factory.

2.2. ENGINE

A. Coupled directly to a generator.

B. Minimum 8-cylinders.

C. Operating speed shall be 1800 RPM.

D. EPA compliant operation.

2.3. GOVERNOR

A. Isochronous; electronic.

B. Steady-state speed band at 60 Hz shall not exceed plus or minus 1/3 of one percent.

C. At 60 Hz, when load changes equal to 25 percent of the specified KW/KVA rating, frequency change shall not exceed two percent and it shall recover to 60 Hz within three seconds.

D. At 60 Hz, when load changes equal to 100 percent of the specified KW/KVA rating, frequency change shall not exceed eight percent and it shall recover to 60 Hz within five seconds.

E. While the engine is running, manual speed adjustments may be made.

2.4. LUBRICATION OIL SYSTEM

A. Pressurized type.

B. Positive-displacement pump driven by engine crankshaft.

C. Full-flow strainer and full-flow or by-pass filters.

D. Filters shall be cleanable or replaceable type and shall remove particles as small as 3 microns without removing the additives in the oil. For by-pass filters, flow shall be diverted without flow interruption.

E. Extend lube oil sump drain line passing out through the skid base and terminate it with a drain valve and plug.

F. Provide a 120-volt oil heater for exterior generator set.

2.5. FUEL SYSTEM

A. Diesel.

2.6. ENGINE COOLING SYSTEM

A. Liquid-cooled, closed loop, with radiator mounted on the engine generator set and integral engine driven circulating.

B. Cooling capacity shall not be less than the cooling requirements of the engine-generator set and its lubricating oil while operating continuously at 110 percent of its specified rating.

C. Coolant shall be extended life antifreeze solution, 50 percent ethylene and 50 percent soft water, with corrosion inhibitor additive as recommended by the manufacturer

D. Radiator core tubes material shall be as recommended by the engine manufacturer.

E. Coolant hoses shall be flexible per manufacturer's recommendation.

F. Self-contained thermostatic-control valve shall modulate coolant flow to maintain optimum constant coolant temperature as recommended by the engine manufacturer.

2.7. AIR INTAKE AND EXHAUST SYSTEMS

A. Air Intake:
   1. Provide an engine-mounted air cleaner with replaceable dry filter and dirty filter indicator.

B. Exhaust System:
   1. Exhaust Muffler:
      a. Shall be Critical grade type and capable of the following noise attenuation:

Octave Band (Mid Frequency)	Hertz Minimum db Attenuation
31	5
63	10
125	27
500	37
1000	31
2000	26
4000	25
8000	26

   2. Pressure drop in the complete exhaust system shall be small enough for satisfactory operation of the engine-generator set while it is delivering 110 percent of its specified rating.
   3. Exhaust pipe size, from the engine to the muffler, shall be as recommended by the engine manufacturer. Pipe size from muffler to air discharge shall be two-pipe sizes larger than engine exhaust pipe.
   4. Connections at the engine exhaust outlet shall be made with a flexible exhaust pipe. Provide bolted type pipe flanges welded to each end of the flexible section.

C. Condensate drain at muffler shall be made with schedule 40 black steel pipe through a petcock.

D. Exhaust Piping and Supports: Black steel pipe, ASTM A-53 standard weight with welded fittings. Spring type hangers shall support the pipe.

2.8. ENGINE STARTING SYSTEM

A. Shall start the engine at any position of the flywheel.

B. Electric cranking motor:

1. Shall be engine mounted.
2. Shall crank the engine via a gear drive.
3. Rating shall be adequate for cranking the cold engine at the voltage provided by the battery system, and at the required RPM during five consecutive starting attempts of 10 seconds cranking each at 10 second intervals, for a total of 50 seconds of actual cranking without damage.

C. Batteries: 12 volt electric with the following features:

1. Batteries shall be lead acid.
2. Each battery cell shall have minimum and maximum electrolyte level indicators, and flip top flame arrestor vent cap.
3. Batteries shall have connector covers for protection against external short circuits.
4. With the charger disconnected, the batteries shall have sufficient capacity so that the total system voltage does not fall below 85 percent of the nominal system voltage with the following demands:
   a. Five consecutive starting attempts of 10 seconds cranking at 10 second intervals for a total of 50 seconds of actual cranking (the fifth starting attempt will be manually initiated upon failure of a complete engine cranking cycle).
5. Battery racks shall be metal with an alkali resistant finish and thermal insulation, and secured to the floor.
6. Battery shall operate continuously for 12 hours and be able to provide the cranking power described in 2.8.B.3 without charging.

D. Battery Charger:

1. The charger shall maintain one percent voltage regulation from no load to full load for line voltage variation of 10 percent and frequency variation of ± 3 Hz from 60 Hz.
2. The charger shall maintain a nominal float voltage of 1.4 vdc and a nominal equalizing voltage of 1.6 vdc.
3. The charger shall be capable of continuous operation in an ambient temperature of –20 to 60 degrees C (-30 to 104 degrees F) without derating. The charger shall be convection cooled and housed in a NEMA 250, Type 1 enclosure. The charger shall have a hinged front door and all components shall be accessible from the front.
4. Provide both AC and DC transient protection. Charger shall be able to recharge a fully discharged battery without tripping AC protective devices. AC circuit breaker shall not trip under any DC load condition including short circuit on output terminals.
5. The charger shall be capable of recharging the fully discharged battery in 12 hours and simultaneously power the Supervisory and Control panel.
6. The charger shall have fused AC input and DC output protection, and shall not discharge the batteries when AC power fails.
7. The charger shall have the following accessories:
   a. On-Off control switch with pilot light.
   b. AC power failure alarm light.
   c. High DC voltage alarm light.
   d. DC voltmeter – 5 percent accuracy.
   e. DC Ammeter – 5 percent accuracy.

2.9. GENERATOR

A. Synchronous, amortisseur windings, bracket-bearing, self-venting, rotating-field type connected directly to the engine.

B. Lifting lugs designed for convenient connection to and removal from the engine at the construction site.

C. Integral poles and spider, or individual poles dove tailed to the spider.

D. Insulation shall be as required for the ambient temperature and other requirements designated in the paragraph, ENGINE GENERATOR SET, in this section.

E. Designed for sustained short circuit currents in conformance with NEMA Standards.

F. Designed for sustained operation at 125 percent of the RPM specified for the generator set without damage.

G. Telephone influence factor shall conform to NEMA Standards.

H. Furnished with brushless excitation system or static exciter regulator assembly.

I. Nameplates attached to the generator and exciter shall show the manufacturer's name, equipment identification, serial number, voltage ratings, field current ratings, KW/KVA output ratings, power factor rating, time rating, temperature rise ratings, RPM ratings, full load current rating, number of phases and frequency, and date of manufacture.

J. At full load, the efficiency shall be not less than:

1. 89 percent for sets specified from 60 KW to 175 KW.
2. 92 percent for sets specified over 175 KW.

K. The neutral shall be electrically isolated from equipment ground and terminated in same junction box as the phase conductors.

L. Main line circuit breaker, size as shown on drawings.

2.10. EQUIPMENT FOR CONTROLS, SUPERVISION AND DISTRIBUTION

A. Shall include Engine Generator Control Panel

1. Control Equipment shall be in accordance with UL 508, NEMA ICS-4, ICS-6 and ANSI C37.90.1.
2. Panels shall be in accordance with UL 50.
3. Incorporate all of the items required to fulfill the requirements in the specifications and on the drawings.
4. Components:
   a. Shall be heavy duty, industrial type.
   b. Electrical contacts shall be precious metal surfaced.
   c. Only heavy duty solid-state components will be accepted.
5. Coordinate controls with the automatic transfer devices shown on the drawings, so that the systems will operate as specified.
6. Panels:
   a. Code gauge steel; manufacturer's recommended heavy gauge steel with factory primer and light gray finish.
   b. Doors shall be gasketed and be attached with concealed or semi-concealed hinges, and shall have a permanent means of latching in closed position.

c. Panels shall be wall mounted or incorporated in other equipment as indicated on the drawings or as specified.
d. Door locks for panels and cubicles shall have identical keying to operate from a single key.
e. Panel installation shall be suitable for convenient maintenance and operation. Overall heights of the cubicles shall not exceed 2.5 meters (90 inches).

7. Wiring: Insulated, rated at 600 volts, UL approved.
   a. Install the wiring in vertical and horizontal runs, neatly harnessed.
   b. Terminate all external wiring at heavy duty, pressure type, terminal blocks.
8. The repetitive accuracy of the monitors shall be as stated over an environmental temperature range of 0 to 45 degrees C (32 to 113 degrees F) and voltage range of 70 to 110 percent of nominal. The accuracy shall not exceed the following limits:

Voltage Monitors	+ 2 percent of set point
Current Monitors	+ 3 percent of set point
Frequency Monitors	+ 0.2 Hz.
Power Monitors	+ 3 percent of set point

9. The manufacturer shall coordinate the interfacing of the control systems with all related equipment supplied in accordance with other sections of the project specification.

B. Engine Generator Control Panel

1. Starting and Stopping Controls:
   a. A three-position, maintained contact type selector switch with positions marked "AUTOMATIC", "OFF" and "MANUAL". Provide flashing amber light for "OFF" and "MANUAL" positions.
   b. A momentary contact pushbutton switch with positions marked "MANUAL START" and "MANUAL STOP".
   c. Selector switch in "AUTOMATIC" position shall cause the engine to start automatically when a single pole contact in a remote device closes. When the generator's output voltage increases to not less than 90 percent of its rated voltage, and its frequency increases to not less than 58 Hz, the remote devices shall transfer the load to the generator. An adjustable time delay relay, 0 to 15 minute range, shall cause the engine generator set to continue operating without any load after completion of the period of operation with load. Upon completion of the additional 0 to 15 minute (adjustable) period, the engine generator set shall stop.

d. Selector switch in "OFF" position shall prevent the engine from starting either automatically or manually. Selector switch in "MANUAL" position shall cause the engine to start when the manual start pushbutton is also depressed momentarily.
e. A maintained contact, red mushroom head pushbutton switch marked "EMERGENCY STOP" will cause the engine to stop without a cool down period independent of the position of the selector switch.

2. Engine Cranking Controls:
   a. The cranking cycles shall be controlled by timer that will be independent of the battery voltage fluctuations.
   b. Shall crank the engine through one complete cranking cycle, consisting of four starting attempts of 10 seconds each and 10 seconds between each attempt.
   c. Total actual cranking time for the complete cranking cycle shall be 40 seconds during a 70 second interval.
   d. Cranking shall terminate when the engine starts so the starting system will not be damaged. Termination of the cranking shall be controlled by self contained, speed sensitive switch. The switch shall prevent re cranking of the engine until after the engine stops.
   e. After the engine has stopped the cranking control shall reset.
3. Supervisory Controls:
   a. Overcrank:
      1) When the cranking control system completes one cranking cycle, four starting attempts, without starting the engine, the "OVERCRANK" signal light and the audible alarm shall be energized.
      2) The cranking control system shall lock out, and shall require a manual reset.
   b. Coolant Temperature:
      1) When the temperature rises to the predetermined first stage level, the "HIGH COOLANT TEMPERATURE FIRST STAGE" signal light and the audible alarm shall be energized.
      2) When the temperature rises to the predetermined second stage level, which shall be low enough to prevent any damage to the engine and high enough to avoid unnecessary engine shutdowns, the "HIGH COOLANT TEMPERATURE SECOND STAGE" signal light and the audible alarm shall be energized and the engine shall stop.
   c. Low Coolant Level: When the coolant level falls below the minimum level recommended by the manufacturer, the "LOW COOLANT LEVEL" signal light and audible alarm shall be energized.
   d. Lubricating Oil Pressure:
      1) When the pressure falls to the predetermined first stage level, the "OIL PRESSURE FIRST STAGE" signal light and the audible alarm shall be energized.

2) When the pressure falls to the predetermined second stage level, which shall be high enough to prevent damage to the engine and low enough to avoid unnecessary engine shutdowns, the "OIL PRESSURE SECOND STAGE" signal light and the audible alarm shall be energized and the engine shall stop.
3) Difference between the first and second stage pressure settings shall be approximately 15 percent of the oil pressure.
4) Permanently indicate the pressure settings near the associated signal light.

e. Overspeed:
1) When the engine RPM exceeds the maximum RPM recommended by the manufacturer of the engine, the engine shall stop.
2) Simultaneously, the "OVERSPEED" signal light and the audible alarm shall be energized.

f. Reset Alarms and Signals: Overcrank, Coolant Temperature, Coolant Level, Oil Pressure, and Overspeed, signal lights and the associated audible alarms shall require manual reset. A momentary contact silencing switch and pushbutton shall silence the audible alarm by using relays of solid state devices to seal in the audible alarm in the de energized condition Elimination of the alarm condition shall automatically release the sealed in circuit for the audible so that it will be automatically energized again when the next alarm condition occurs

4. Monitoring Devices:
a. Electric type gauges for the cooling water temperatures and lubricating oil pressures. These gauges may be engine mounted with proper vibration isolation.
b. A running time indicator, totalizing not less than a 9,999 hour, heavy duty and an electric type tachometer.
c. Voltmeter, ammeter, and their selector switches, frequency meter, kilowatt meter, manual adjusting knob for the output voltage and the other items shown on the drawings shall be mounted on the front of the generator control panels.
d. Install potential and current transformers as required.
e. Individual signal lights:
1) OVER CRANK
2) HIGH COOLANT TEMPERATURE FIRST STAGE
3) HIGH COOLANT TEMPERATURE SECOND STAGE
4) LOW COOLANT TEMPERATURE
5) OIL PRESSURE FIRST STAGE
6) OIL PRESSURE SECOND STAGE
7) LOW COOLANT LEVEL
8) GENERATOR BREAKER
9) OVERSPEED

f. Lamp Test: "Lamp Test" momentary contact switch shall momentarily actuate the alarm buzzer and all the indicating lamps.

5. Power switching and overcurrent protection shall be accomplished with molded case circuit breakers.
   a. Molded Case Circuit Breakers shall have the following features:
      1) Shall be in accordance with UL 489 and NEMA AB-1
      2) Electrically and mechanically trip free.
6. Automatic Voltage Regulator:
   a. Shall maintain the generator's output voltage within plus or minus one percent for load variations between no load and full load.
   b. Shall correct voltage fluctuations rapidly and restore the output voltage to the predetermined level with a minimum amount of hunting.
   c. Shall include voltage level rheostat located inside the control cubicle.
7. Governor: Specified herein before in Article 2.3 "GOVERNOR".
8. The voltage regulator and other components of the auxiliary electrical power system shall be protected during operation of the engine generator set at speeds other than the rated RPM while performing maintenance by a power monitoring system which monitors single phase and three phase faults. A time-delay relay shall shut down the engine when the alternator thermal capacity is exceeded.

2.11. SOUND ATTENUATED ENCLOSURE

A. The emergency generator set and related equipment shall be housed in an outdoor weatherproof enclosure. The generator will function properly without overheating in the ambient conditions specified. Enclosure shall be weatherproof and sound attenuated (maximum 85 dBA at 1525 mm (five feet) from any side, top and bottom to no more than 75 dBA when measured at 15 meters (50 feet) horizontally from any part of the enclosure). Sound ratings shall be based on full load condition of engine/generator in a single unit operation condition. Airflow configuration of the unit will be intake through rear of unit and discharge air vertically up. Enclosure shall be manufacturer’s standard wind resistance.

B. The enclosure shall meet the following requirements:

1. The exterior finish shall be guaranteed for a period of 10 years to be free from any defects when properly maintained.
2. Radiator exhaust outlet shall be ducted through the end of the enclosure.
3. All exterior surfaces shall be factory painted with industrial enamel.
4. Unit shall have sufficient guards to prevent entrance by small animals.

5. Batteries to fit inside enclosure and along side the engine provide protective shield. (Batteries under the generator are not acceptable.)

C. Exhaust System: The silencer shall be critical grade, mounted and thermally insulated inside the enclosure. Insulation must be provided for the silencer, flex and all discharge piping. The weight of the silencer shall not be supported by engine. The exhaust pipe size shall be sufficient to insure that exhaust backpressure does not exceed the maximum limitations specified by the engine manufacturer. The exhaust silencer outlet roof penetration shall be sealed to prevent the entrance of rain, snow and sleet. A stainless steel bellowed flex shall be provided.

2.12. SPARE PARTS

A. For each engine generator set:

1. Two lubricating oil filters.
2. Two intake air filters.

PART 3. EXECUTION

3.1. INSTALLATION

A. Install concrete bases of dimensions shown on the drawings for packaged engine-generator sets.

B. Installation of the engine generator set shall comply with manufacturer's written instructions and with NFPA 110.

C. Mounting

1. Support the base of engine generator set on vibration isolators, each isolator bolted to the floor (pad), generator base bolted to isolator.
2. Install sufficient number of isolators so that the floor (pad) bearing pressure under each isolator is within the floor (pad) loading specification.
3. Install equal number of isolators on each side of the engine generator set's base.
4. Locate isolators for approximately equal load distribution and deflection per isolator. Base of the engine generator set shall be drilled at the factory for the isolator bolts.
5. Isolators shall be shipped loose with the engine generator set.

6. All connections between the engine generator set and exterior systems, such as fuel lines, electrical connections, and engine exhaust system and air exhaust shroud, shall be flexible.

D. Balance:

1. The vibration velocity in the horizontal, vertical, and axial directions shall not exceed 16.25 mm (0.65 inch) per second peak at any specific frequency. These limits apply to main structural components such as the engine block and the generator frame at the bearings.
2. Balance the engine generator set statically and dynamically at the factory in order to comply with the maximum specified vibration velocity.

E. Connect all components of the essential electrical power system so that they will continue to be energized by the auxiliary electrical power system during failures of the normal electrical power supply system.

F. Install piping between engine and remote components of cooling, fuel and exhaust systems.

G. Flexible connection between radiator and exhaust shroud at the wall damper:

1. Install noncombustible flexible connections made of 20-ounce neoprene coated fiberglass fabric approximately 150 mm (six inches) wide.
2. Crimp and fasten the fabric to the sheet metal with screws 50 mm (two inch) on center. The fabric shall not be stressed, except by the air pressure.

H. Exhaust System Insulation:

1. Adhesive and insulation materials shall be applied on clean, dry surfaces from which loose scale, and construction debris has been removed by wire brushing.
2. Fill all cracks, voids and joints of applied insulation material with high temperature 1093 degrees C (2000 degrees F) insulating cement before applying the outer covering.
3. The installation shall be neat, thermally and structurally tight without sag, neatly finished at all hangers or other penetrations and shall provide a smooth finish surface.
4. Insulation and jacket shall terminate hard and tight at all anchor points.
5. Insulate completely from engine exhaust flexible connection through roof or wall construction, including muffler.

3.2. START UP AND TESTING

A. Provide the services of a factory-authorized, factory trained representative of the engine generator set manufacturer to inspect field-assembled components, and equipment installation and supervise the field tests

B. When the complete auxiliary electrical power system has been installed and prior to the final inspection, tests all components of the system.

C. Field Tests for the Engine Generator Set:

1. Test the engine generator set for two hours of continuous operation as follows:
2. Record the following test data at 30-minute intervals:
   a. Time of day, also reading of running time indicator.
   b. KW.
   c. Voltage on each phase.
   d. Amperes on each phase.
   e. Engine RPM.
   f. Frequency.
   g. Engine water temperature.
   h. Oil pressure.
   i. Outdoor temperature
   j. Average ambient temperature in the vicinity of the engine.
   k. Average ambient temperature in the vicinity of the starting batteries.
3. Demonstrate that the generator set will attain proper voltage, frequency and will accept 100 percent block load within 10 seconds from a cold start after the closing of a single contact.

D. Battery and Starting System Test:
1. Demonstrate that the batteries and cranking motor are capable of 5 starting attempts of 10 second cranking each at 10 second intervals with the battery charger turned off.

E. When any defects are detected during the tests, correct all the deficiencies and repeat tests

3.3. INSTRUCTIONS AND FINAL INSPECTIONS

A. Laminate or mount under Plexiglas a set of operating instructions for the system and install instructions within a frame mounted on the wall near the engine.

B. Furnish the services of a competent, factory trained engineer or technician for one, 4 hour period for instructions to owner personnel in operation and maintenance of the equipment.

END OF SECTION

SECTION 26 36 23 - AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
   1. Provide Payment and Performance Bonds for the full value of their Subcontract.
   2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
   1. Comply with the Instructions to Bidders.
   2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
   3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
   4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
      FILED SUBCONTRACTOR'S BID FOR SECTION:
      26 36 23 – Automatic Transfer Switches

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
   1. All subcontractors to the Filed Subcontractor, whose work is:
      a. Subject to the provisions of MGL Chap. 149, §§ 44A-J.
      b. Valued at $10,000 or more.
   2. The contract sum for each subcontractor required to be listed.
      a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
   3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
   4. Comply with the applicable Mass. General Laws and the following:
      a. Sub bidder's attention is directed to Massachusetts G.L. Chapter 149 Section 44F, as amended, which provides in part as follows.
      b. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such

listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None**.**	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. E1.01 – Lighting Plan
2. E2.01 – Power Plan
3. E2.02 – Power Roof Top Plan
4. E3.00 – Electrical Details
5. E4.00- Electrical Notes
6. FA1.01- Fire Alarm Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 26 05 00 – Basic Method and Requirements (Electrical)
2. Section 26 05 21 – Cables, Low Voltage (600 Volts and Below)
3. Section 26 05 26 – Grounding
4. Section 26 05 33 – Raceway Systems
5. Section 26 05 41 – Underground Electrical Construction
6. Section 26 22 00 – Low-Voltage Transformers
7. Section 26 24 16 – Panelboards
8. Section 26 27 26 – Wiring Devices
9. Section 26 29 21 – Disconnects (Motor and Circuit)
10. Section 26 32 13 – Engine Generators
11. Section 26 36 23 – Automatic Transfer Switches
12. Section 26 51 00 – Interior Lighting
13. Section 28 31 64 – Fire Alarm Local Building System

B. Alternates: None.

1.3. DESCRIPTION

This section specifies the furnishing, complete installation, and connection of automatic transfer switches.

1.4. RELATED WORK

A. Section 26 05 00, BASIC METHODS AND REQUIREMENTS (ELECTRICAL): General electrical requirements and items that is common to more than one section of Division 26.

B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and Wiring.

C. Section 26 32 13, ENGINE GENERATORS: Requirements for emergency power generation.

D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personal safety and to provide a low impedance path for possible ground fault currents.

1.5. QUALITY ASSURANCE

A. Factory authorized representative shall maintain a service center capable of providing emergency maintenance and repair services at the project site within 4 hour maximum response time.

B. Automatic transfer switch, bypass/isolation switch and annunciation control panels shall be products of same manufacturer.

1.6. SUBMITTALS

A. Submit in accordance with Section 26 05 00, BASIC METHODS AND REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

B. Shop Drawings:

1. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
2. Include electrical ratings (including withstand), dimensions, weights, mounting details, conduit entry provisions front view, side view, equipment and device arrangement, elementary and interconnection wiring diagrams, and accessories.
3. Complete nameplate data, including manufacturer's name and catalog number.
4. A copy of the markings that are to appear on the transfer switches when installed.

C. Manuals:

1. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating and maintenance manuals including technical data sheets, wiring diagrams and information, such as telephone number, fax number and web sites, for ordering replacement parts.
2. Two weeks prior to final inspection, submit four copies of a final updated maintenance and operating manual to the Engineer
   a. Include complete "As installed" diagrams, which indicate all items of equipment and their interconnecting wiring.
   b. Include complete diagrams of the internal wiring for each of the items of equipment, including "As installed" revisions of the diagrams.
   c. The wiring diagrams shall identify the terminals to facilitate installation, maintenance, operation and testing.

D. Certifications:

1. Submit, simultaneously with the shop drawings, a certified test report from a recognized independent testing laboratory that a representative sample has passed UL 1008 (Prototype testing).
2. Additionally when transfer switches are used with power air circuit breakers having short-time trip elements without instantaneous trip elements provide a certified test report showing that the sample has passed the additional withstand requirements of this specification. Method of test shall be in accordance with UL 1008. Main contact separation as measured by an oscillograph voltage trace across the contacts will not be allowed during this test. Welding or burning of contacts is unacceptable.

1.7. APPLICABLE PUBLICATIONS

Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only:

A. Institute of Electrical and Electronic Engineers (IEEE):

446 Recommended Practice for Design and Maintenance of Emergency and Standby Power Systems

C37.90.1 IEEE Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems

B. National Electrical Manufacturers Association (NEMA):

250 Enclosure for Electrical Equipment (1000 Volts Maximum).

ICS 6 Industrial Control and Systems Enclosures

IC3 4 Industrial Control and Systems: Terminal Blocks

MG 1 Motors and Generators, Revision 1

C. National Fire Protection Association (NFPA):

70 National Electrical Code (NEC)

99 Health Care Facilities

110 Emergency and Standby Power Systems

D. Underwriters Laboratories, Inc. (UL):

50 Enclosures for Electrical Equipment

508 Industrial Control Equipment

891 Dead-Front Switchboards

1008 Transfer Switch Equipment

PART 2. PRODUCTS

2.1. AUTOMATIC TRANSFER SWITCHES

A. General:

1. Comply with UL, NEMA, NEC, ANSI and NFPA.
2. Automatic transfer switches are to be electrically operated, mechanically held open contact type, without integral overcurrent protection. Transfer switches utilizing automatic or non-automatic molded case circuit breakers as switching mechanisms are not acceptable.
3. The unit shall be completely factory-assembled and wired so that only external circuit connections are required in the field. The unit shall include, but not be limited to,

operating mechanism, main contacts, auxiliary contacts, timers, pilot lights, switches, and auxiliary sensing devices.

B. Ratings, Markings and Tests:

1. Ratings:

   a. Phase, voltage, ampere rating, number of poles, withstand rating shall be as shown on the drawings. The ampere rating shall be for 100 percent continuous load current.
   b. Transfer switches are to be rated for total system transfer on emergency systems.
   c. Ratings shall be with non-welding of contacts during the performance of withstand and closing tests.

2. Markings:

   a. Markings shall be in accordance with UL 1008.
   b. Markings for the additional withstand test hereinafter specified shall be included in the nameplate data.

3. Tests:
   a. Transfer switches shall be tested in accordance with UL 1008. The contacts of the transfer switch shall not weld during the performance of withstand and closing tests when used with the upstream overcurrent device.
   b. Where used with molded case circuit breakers or power air circuit breakers with long-time and instantaneous trip, transfer switch withstand and closing rating shall equal or exceed the available short circuit current shown on the drawings, but shall not be less than the following:

Switch Rating(Amperes)	Withstanding Amperes(RMS Symmetrical)
Up to 100	22,000 Per UL
101 to 260	35,000 Per UL
261 to 400	42,000 Per UL
410 to 600	50,000 Per UL
601 to 1200	65,000 Per UL
1201 to 4000	85,000 Per UL

C. Housing:

1. Enclose transfer switches in steel cabinets in accordance with UL 508, or in a switchboard assembly in accordance with UL 891, as shown on the drawings. NEMA ICS 6 Type as indicated on the drawings.
2. Doors: Shall have three-point latching mechanism.
3. Padlocking Provisions: Provide chain for attaching a padlock. Attach chain to the cabinet by welding or riveting.
4. Finish: Cabinets shall be given a phosphate treatment, painted with rust inhibiting primer, and finish painted with the manufacturer's standard enamel or lacquer finish.

2.2. FEATURES

A. Transfer switches shall include the following features:

1. Operating Mechanism:

a. Actuated by an electrical operator.
b. Electrically and mechanically interlocked so that the main contact cannot be closed simultaneously in both normal and emergency position.
c. Normal and emergency main contacts shall be mechanically locked in position by the operating linkage upon completion of transfer. Release of the locking mechanism shall be possible only by normal operating action.
d. Contact transfer time shall not exceed six cycles.
e. Do not use as a current carrying part. Components and mechanical interlocks shall be insulated or grounded.

2. Contacts:

a. For switches 400 amperes and larger, protect main contacts by separate arcing contacts and magnetic blowouts for each pole. Arc quenching provisions equivalent to magnetic blowouts will be considered acceptable.
b. Current carrying capacity of arcing contacts shall not be used in the determination of the transfer switch rating, and shall be separate from the main contacts.
c. Main and arcing contacts shall be visible for inspection with cabinet door open and barrier covers removed.

3. Manual Operator:
a. Capable of operation in either direction under no load.
b. Capable of operation by one person.
c. Provide a warning sign to caution against operation when energized.

4. Replaceable Parts:
    a. Include the main and arcing contact individually or as units, relays, and control devices.
    b. Switch contacts and accessories are to be replaceable from the front without removing the switch from the cabinet and without removing main conductors.
5. Controls:
    a. Control module shall provide indication of switch status –emergency, normal, and be equipped with alarm diagnostic circuitry.
    b. Control module shall control operation of the transfer switch. The sensing and the logic shall be controlled by a microprocessor equipped with digital communication and battery backup. The control shall comply with IEEE 472.

2.3. ACCESSORIES

A. Transfer switches shall include the following accessories:

1. Indicating Lights of different colors:
    a. Green Signal light for normal source position.
    b. Red Signal light for emergency source position.
2. Laminated black phenolic nameplates with white letters to indicate transfer switch position.

B. Manual Test Switch for simulating normal source failure.

C. Engine starting contacts.

D. Time delay relay to accomplish the function as specified.

E. Auxiliary Contacts:

1. For projects including an elevator load, provide contacts for connection to elevator controllers, one closed when transfer switch is connected to normal, and one closed when transfer switch is connected to emergency.
2. Provide additional contacts as necessary to accomplish the functions shown on the drawings, specified, and designated in other sections of these specifications and one spare normally open and normally closed contact.
3. Contacts shall have a minimum rating of ten amperes and be positive acting on pickup and dropout.

2.4. TRANSFER SWITCH OPERATION

A. A voltage decrease in one or more phases of the normal power source to less than 70 percent of normal shall initiate the transfer sequence. The transfer switch shall start the engine-generator unit after a time delay of two or three seconds to permit override of momentary dips in the normal power source. The time-delay shall be field adjustable from zero to fifteen seconds.

B. The transfer switch shall transfer the load from normal to emergency source when the frequency and voltage of the engine generator unit have attained 90 percent of rated value.

C. The transfer switch shall retransfer the load from emergency to normal source upon restoration of normal supply in all phases to 90 percent or more of normal voltage, and after a time delay. The time delay shall be field adjustable from five to twenty-five minutes (preset for twenty-five minutes). Should the emergency source fail during this time, the transfer switch shall immediately transfer to the normal source whenever it becomes available. After restoring to normal source, the generator shall continue to run for five minutes unloaded before shut down. Time delay shall be adjustable from zero to fifteen minutes.

PART 3. EXECUTION

3.1. INSTALLATION

A. Install automatic transfer switch(s) in accordance with the NFPA and as shown on the drawings.

B. Level and anchor the automatic transfer(s) switch to floor or wall.

C. Ground equipment as shown on the drawings and as required by NFPA 70.

3.2. START UP AND TESTING

A. After the complete system has been installed, and before energizing the system, check all components of the system, including insulation resistance, phase to phase and phase to ground, complete electrical circuitry and safety features according to the manufacturer's written instructions

B. After energizing circuits, test the interlocking sequence and operation of the complete system, including time delays of transfer from normal source to emergency and back to normal source, pick-up and voltage drop.

C. When any defects are detected, correct the defects and repeat the test until normal operation is achieved.

3.3. TRAINING

Furnish the services of a competent, factory-trained engineer or technician for one four-hour period for instructing the owners representative in operation and maintenance of the equipment, including review of the operation and maintenance manual. Coordinate this training with that of the generator training.

END OF SECTION

SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
   1. Provide Payment and Performance Bonds for the full value of their Subcontract.
   2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
   1. Comply with the Instructions to Bidders.
   2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
   3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
   4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
      FILED SUBCONTRACTOR'S BID FOR SECTION:
      26 51 00 – Interior Lighting

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
   1. All subcontractors to the Filed Subcontractor, whose work is:
      a. Subject to the provisions of MGL Chap. 149, §§ 44A-J.
      b. Valued at $10,000 or more.
   2. The contract sum for each subcontractor required to be listed.
      a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
   3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
   4. Comply with the applicable Mass. General Laws and the following:
      a. Sub bidder's attention is directed to Massachusetts G.L. Chapter 149 Section 44F, as amended, which provides in part as follows.
      b. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications,

any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None.	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. E1.01 – Lighting Plan
2. E2.01 – Power Plan
3. E2.02 – Power Roof Top Plan
4. E3.00 – Electrical Details
5. E4.00- Electrical Notes
6. FA1.01- Fire Alarm Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 26 05 00 – Basic Method and Requirements (Electrical)
2. Section 26 05 21 – Cables, Low Voltage (600 Volts and Below)
3. Section 26 05 26 – Grounding
4. Section 26 05 33 – Raceway Systems
5. Section 26 05 41 – Underground Electrical Construction
6. Section 26 22 00 – Low-Voltage Transformers
7. Section 26 24 16 – Panelboards
8. Section 26 27 26 – Wiring Devices
9. Section 26 29 21 – Disconnects (Motor and Circuit)
10. Section 26 32 13 – Engine Generators
11. Section 26 36 23 – Automatic Transfer Switches
12. Section 26 51 00 – Interior Lighting
13. Section 28 31 64 – Fire Alarm Local Building System

B. Alternates: None.

1.3. DESCRIPTION:

This section specifies the furnishing, installation and connection of the interior lighting systems.

1.4. RELATED WORK

A. Section 26 05 00, BASIC METHODS AND REQUIREMENTS (ELECTRICAL): General requirements that are common to more than one section of Division 26.

B. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Cables and wiring.

C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.

D. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.

1.5. QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 00, BASIC METHODS AND REQUIREMENTS (ELECTRICAL).

1.6. SUBMITTALS

A. In accordance with Section 26 05 00, BASIC METHODS AND REQUIREMENTS (ELECTRICAL), submit the following:

B. Product Data: For each type of lighting fixture (luminaire) designated on the LIGHTING FIXTURE SCHEDULE, arranged in order of fixture designation, submit the following information.

1. Material and construction details include information on housing, optics system and lens/diffuser.
2. Physical dimensions and description.
3. Wiring schematic and connection diagram.
4. Installation details.
5. Energy efficiency data.

6. Photometric data based on laboratory tests complying with IESNA Lighting Measurements, testing and calculation guides.
7. Lamp data including lumen output (initial and mean), color rendition index (CRI), rated life (hours) and color temperature (degrees Kelvin).
8. Ballast data including ballast type, starting method, ambient temperature, ballast factor, sound rating, system watts and total harmonic distortion (THD).

1.7. APPLICABLE PUBLICATIONS

Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

A. Institute of Electrical and Electronic Engineers (IEEE):

C62.41 Guide on the Surge Environment in Low Voltage (1000V and less) AC Power Circuits

B. National Fire Protection Association (NFPA):

70 National Electrical Code (NEC)

101 Life Safety Code

C. National Electrical Manufacturer's Association (NEMA):

C82.1 Ballasts for Fluorescent Lamps - Specifications

C82.2 Method of Measurement of Fluorescent Lamp Ballasts

C82.4 Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps

C82.11 High Frequency Fluorescent Lamp Ballasts

D. Underwriters Laboratories, Inc. (UL):

496-96 Edison-Base Lampholders

542-99 Lampholders, Starters, and Starter Holders for Fluorescent Lamps

844-95 Electric Lighting Fixtures for Use in Hazardous (Classified) Locations

924-95 Emergency Lighting and Power Equipment

935-01 Fluorescent-Lamp Ballasts

1029 High-Intensity-Discharge Lamp Ballasts

1029A. Ignitors and Related Auxiliaries for HID Lamp Ballasts

1598 Luminaires

1574. Standard for Track Lighting Systems

2108. Standard for Low-Voltage Lighting Systems

8750. Light Emitting Diode (LED) Light Sources for Use in Lighting Products

E. Federal Communications Commission (FCC):

Code of Federal Regulations (CFR), Title 47, Part 18

PART 2. PRODUCTS

2.1. LIGHTING FIXTURES (LUMINAIRES)

A. Shall be in accordance with NFPA 70 and UL 1598, as shown on drawings, and as specified.

B. Sheet Metal:

1. Shall be formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved) and parallel to each other as designed.
2. Wireways and fittings shall be free of burrs and sharp edges and shall accommodate internal and branch circuit wiring without damage to the wiring.
3. When installed, any exposed fixture housing surface, trim frame, door frame and lens frame shall be free of light leaks; lens doors shall close in a light tight manner.
4. Hinged door closure frames shall operate smoothly without binding when the fixture is in the installed position, latches shall function easily by finger action without the use of tools.

C. Ballasts shall be serviceable while the fixture is in its normally installed position, and shall not be mounted to removable reflectors or wireway covers unless so specified.

D. Lamp Sockets:

1. Fluorescent: Lampholder contacts shall be the biting edge type or phosphorous-bronze with silver flash contact surface type and shall conform to the applicable requirements of UL 542. Lamp holders for bi pin lamps shall be of the telescoping compression type, or of the single slot entry type requiring a one-quarter turn of the lamp after insertion.
2. High Intensity Discharge (H.I.D.): Shall have porcelain enclosures.

E. Recessed fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.

F. Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, captive hinges or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.

G. Metal Finishes:

1. The manufacturer shall apply standard finish (unless otherwise specified) over a corrosion resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking, and shall be applied after fabrication.
2. Interior light reflecting finishes shall be white with not less than 85 percent reflectance, except where otherwise shown on the drawing.
3. Exterior finishes shall be as shown on the drawings.

H. Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.

I. Light Transmitting Components for Fluorescent Fixtures:

1. Shall be 100 percent virgin acrylic.
2. Flat lens panels shall have not less than 1/8 inch [3.2mm] of average thickness. The average thickness shall be determined by adding the maximum thickness to the minimum un-penetrated thickness and dividing the sum by 2.
3. Unless otherwise specified, lenses, diffusers and louvers shall be retained firmly in a metal frame by clips or clamping ring in such a manner as to allow expansion and contraction of the lens without distortion or cracking.

J. Lighting fixtures in hazardous areas shall be suitable for installation in Class and Group areas as defined in NFPA 70, and shall comply with UL 844.

K. Compact fluorescent fixtures shall be manufactured specifically for compact fluorescent lamps with ballast integral to the fixture. Assemblies designed to retrofit incandescent fixtures are prohibited except when specifically indicated for renovation of existing fixtures (not the lamp) or so indicated on the fixture schedule. Fixtures shall be designed for lamps as specified.

2.2. BALLASTS

A. Linear Fluorescent Lamp Ballasts: Multi-voltage (120 – 277V) electronic programmed-start or rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated; including the following features:

1. Lamp end-of-life detection and shutdown circuit (T5 lamps only).
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: Class A.
4. Total Harmonic Distortion Rating: 10 percent or less.
5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. Ballast Factor: 0.87 or higher unless otherwise indicated.
9. Power Factor: 0.98 or higher.
10. Interference: Comply with 47 CFT 18, Ch.1, Subpart C, for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.
11. To facilitate multi level lamp switching, lamps within fixture shall be wired with the outermost lamp at both sides of the fixture on the same ballast, the next inward pair on another ballast and so on to the innermost lamp (or pair of lamps). Within a given room, each switch shall uniformly control the same corresponding lamp (or lamp pairs) in all fixture units that are being controlled.
12. Where three lamp fixtures are indicated, unless switching arrangements dictate otherwise, utilize a common two lamp ballast to operate the center lamp in pairs of adjacent units that are mounted in a continuous row. The ballast fixture and slave lamp fixture shall be factory wired with leads or plug devices to facilitate this circuiting. Individually mounted fixtures and the odd fixture in a row shall utilize a single lamp ballast for operation of the center lamp.

13. Dimming ballasts shall be as per above, except dimmable from 100% to 20% of rated lamp lumens.

B. Compact Fluorescent Lamp Ballasts: Multi-voltage (120 – 277V), electronic-programmed rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated; including the following features:

1. Lamp end-of-life detection and shutdown circuit.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: Class A.
4. Total Harmonic Distortion Rating: 10 percent or less.
5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. Ballast Factor: 0.95 or higher unless otherwise indicated.
9. Power Factor: 0.98 or higher.
10. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.
11. Dimming ballasts shall be as per above, except dimmable from 100% to 20% of rated lamp lumens.

C. Ballasts for high intensity discharge fixtures: Multi-tap voltage (120- 480v) electromagnetic ballast for high intensity discharge lamps. Comply with ANSI C82.4 and UL 1029. Include the following features unless otherwise indicated:

1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
2. Minimum Starting Temperature: Minus 22 deg F (Minus 30 deg C) for single-lamp ballasts.
3. Rated Ambient Operating Temperature: 104 deg F (40 deg C).
4. Open-circuit operation that will not reduce average life.
5. Low-Noise Ballasts: Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.

D. Electronic ballast for high intensity discharge metal-halide lamps shall include the following features unless otherwise indicated:

1. Minimum Starting Temperature: Minus 20 deg F (Minus 29 deg C) for single-lamp ballasts.
2. Rated Ambient Operating Temperature: 130 deg F (54 deg C).
3. Lamp end-of-life detection and shutdown circuit.
4. Sound Rating: Class A.
5. Total Harmonic Distortion Rating: 20 percent or less.
6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
7. Lamp Current Crest Factor: 1.5 or less.
8. Power Factor: 0.90 or higher.
9. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.
10. Protection: Class P thermal cut.

2.3. FLUORESCENT EMERGENCY BALLAST

A. Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.

1. Emergency Connection: Operate one fluorescent lamp continuously at an output of 1100 lumens each. Connect un-switched circuit to battery-inverter unit and switched circuit to fixture ballast.
2. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
   a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
   b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
3. Battery: Sealed, maintenance-free, nickel-cadmium type.
4. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
5. Integral Self-Test: Automatically initiates test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing LED.

2.4. EMERGENCY LIGHTING UNIT

A. Complete, self-contained unit with batteries, battery charger, one or more local or remote lamp heads with lamps, under-voltage relay, and test switch. Comply with UL 924.

1. Enclosure: Unless indicated otherwise on the fixture schedule, shall be impact-resistant thermoplastic, which will protects components from dust, moisture, and oxidizing fumes from the battery. Enclosure shall be suitable for the environmental conditions in which installed.
2. Lamp Heads: Horizontally and vertically adjustable, mounted on the face of the unit, except where otherwise indicated.
3. Lamps: Shall be sealed-beam MR-16 halogen or LED as indicated on the fixture schedule.
4. Battery: Shall be maintenance-free lead-acid. Minimum normal life shall be 10 years.
5. Battery Charger: Dry-type full-wave rectifier with charging rates to maintain the battery in fully-charged condition during normal operation, and to automatically recharge the battery within 12 hours following a 1-1/2 hour continuous discharge.
6. Integral Self-Test: Automatically initiates test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing LED.

2.5. LAMPS

A. Linear and U-shaped T5 and T8 Fluorescent Lamps:

1. Rapid start fluorescent lamps shall comply with ANSI C78.1; and instant-start lamps shall comply with ANSI C78.3.
2. Chromacity of fluorescent lamps shall comply with ANSI C78.376.
3. Except as indicated below, lamps shall be low-mercury energy saving type, have a color temperature between 3500□ and 4100□K, a Color Rendering Index (CRI) of greater than 70, average rated life of 20,000 hours, and be suitable for use with dimming ballasts, unless otherwise indicated. Low mercury lamps shall have passed the EPA Toxicity Characteristic Leachate Procedure (TCLP) for mercury by using the lamp sample preparation procedure described in NEMA LL 1.

B. Compact Fluorescent Lamps:

1. T4, CRI 80 (minimum), color temperature 3500 K, and suitable for use with dimming ballasts, unless otherwise indicated.

C. Long Twin-Tube Fluorescent Lamps:

1. T5, CRI 80 (minimum), color temperature between 3500□ and 4100□K, 20,000 hours average rated life.

D. High Intensity Discharge Lamps:

1. High-Pressure Sodium Lamps: ANSI C78.42, CRI 21 (minimum), color temperature 1900□K, and average rated life of 24,000 hours, minimum.
2. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000□K.
3. Ceramic, Pulse-Start, Metal-Halide Lamps: CRI 80 (minimum), and color temperature 4000□K.
4. Low-Pressure Sodium Lamps: ANSI 78.41, CRI 0, and color temperature 1800□K.

2.6. EXIT LIGHT FIXTURES

A. Exit light fixtures shall meet applicable requirements of NFPA 101 and UL 924.

B. There shall be no radioactive material used in the fixtures.

C. Fixtures:

1. Maximum fixture wattage shall be 1 watt or less.
2. Inscription panels shall be cast or stamped aluminum a minimum of 0.090 inch [2.25mm] thick, stenciled with 6 inch [150mm] high letters, baked with red color stable plastic or fiberglass. Lamps shall be luminous Light Emitting Diodes (LED) mounted in center of letters on red color stable plastic or fiberglass. The LED shall be rated minimum 25 years life.
3. Double-Faced Fixtures: Provide double-faced fixtures where required or as shown on drawings.
4. Directional Arrows: Provide directional arrows as part of the inscription panel where required or as shown on drawings. Directional arrows shall be the "chevron-type" of similar size and width as the letters and meet the requirements of NFPA 101.
5. Voltages: Multi-voltage (120/277)

2.7. LED FIXTURES

A. Compliance: UL listed, Energy Star qualified.

B. Performance

1. Nominal Light Output: At least 650 lumens or as shown on drawings
2. CRI: 80 or as shown on drawings or model number.
3. CCT: 3500 or as shown on the fixture schedule.

C. Input Power: 120 volts, nominal, with integrated power supply with power factor 0.95 or higher or multi-volt (120-277).

D. Optical System: Uniform appearance, LED's shielded from direct view.

E. Heat Rejection: Integrated thermal management system.

F. Lifetime: design for 50,000 hrs. with minimum of 70% output.

G. Housing: Recessed new construction.

H. Trim: Smooth white.

I. Warranty: 3 years.

PART 3. EXECUTION

3.1. INSTALLATION

A. Installation shall be in accordance with the NEC, manufacturer's instructions and as shown on the drawings or specified.

B. Align, mount and level the lighting fixtures uniformly.

C. Lighting Fixture Supports:

1. Shall provide support for all of the fixtures. Supports may be anchored to channels of the ceiling construction, to the structural slab or to structural members within a partition, or above a suspended ceiling.
2. Shall maintain the fixture positions after cleaning and relamping.
3. Shall support the lighting fixtures without causing the ceiling or partition to deflect.

D. Furnish and install the specified lamps for all lighting fixtures installed and all existing lighting fixtures reinstalled under this project.

E. Coordinate between the electrical and ceiling trades to ascertain that approved lighting fixtures are furnished in the proper sizes and installed with the proper devices (hangers, clips, trim frames, flanges), to match the ceiling system being installed.

F. Exercise electronic dimming ballasts over full range of dimming capability by operating the control devices(s). Observe for visually detectable flicker over full dimming range.

G. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by the owner. Burn-in period to be 40 hours minimum, unless a lesser period is specifically recommended by lamp manufacturer. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage. Replace any lamps and ballasts which fail during burn-in.

H. At completion of project, re-lamp/re-ballast fixtures which have failed lamps/ballasts. Clean fixtures, lenses, diffusers and louvers that have accumulated dust/dirt/fingerprints during construction. Replace damaged lenses, diffusers and louvers with new.

END OF SECTION

SECTION 265600

SITE LIGHTING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Exterior luminaire and accessories, underground conduit, wiring, and termination.

2. Poles and foundations.

3. Component installation and system testing.

4. Removal of existing overhead wires, light fixtures, and light poles as shown on the Drawings.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 31 00 00 – Earthwork

2. Section 32 12 16 – Bituminous Concrete Paving

3. Site Electrification Drawings

1.3 REFERENCE STANDARDS

A. ANSI C78.379 - Electrical Lamps - Incandescent and High-Intensity Discharge Reflector Lamps - Classification of Beam Patterns

B. ANSI/NFPA 70 - National Electrical Codes

C. ANSI/IES RP-8 - Recommended Practice for Roadway Lighting

D. ANSI/IES RP-20 - Lighting for Parking Facilities

E. IES Lighting Handbook - Current Edition

F. NEMA – Best practices for metal halide lighting systems

G. IES DG-5-94 – Recommended lighting for walkways and class I bikeways

H. NECA/IESNA 501-2000 – Recommended practice for installing exterior lighting systems

I. IESNA G-1-02 – Guideline for security lighting for people, property and public spaces

J. IESNA RP-06-01 – Recommended practice for sports and recreational area lighting

K. AASHTO – Standard specifications for structural supports for highway signs, luminaire and traffic signals, 4th edition (2003 interim)

L. IESNA LM-79 - Electrical and Photometric Measurements of Solid-State Lighting Products

M. IESNA LM-80 - Approved Method for Measuring Lumen Maintenance of LED Light Sources

1.4 QUALITY ASSURANCE

A. Contractor to verify that all specified site lighting satisfies all applicable guidelines and regulations of local utility provider.

B. Once Shop Drawings, are approved, all lighting is to be ordered in a timely manner. The Contractor is then to inform the Landscape Architect/Engineer immediately, in writing, the date when equipment orders are completed and delivery scheduled.

C. The Owner reserve the right to request standard production model fixture samples for inspection and to order such tests as the Owner deems necessary to insure compliance with these specifications and to reject those luminaire failing such tests, or those luminaire with improper or inadequate light distributions. The Owner shall be the sole judge as to acceptability.

1.5 SUBMITTALS

A. Contractor shall submit 3 color samples for all new light fixtures and poles to the Landscape Architect for approval.

B. When required by the Owner, each submittal transmitted for approval shall contain:

C. Computer prepared photometric layout of the proposed lighted area, which indicates by isofootcandle readings the system performance.

D. A photometric report from a national independent testing laboratory with report number, date, fixture catalog number, luminaire and lamp specifications; IES calculations, candlepower tabulations, zone lumen summary and isolux plot.

E. The Underwriters Laboratory listing and file number for the specific fixture(s) to be utilized.

F. Pole manufacturer AASHTO calculations indicating the pole and anchor bolts being submitted are capable of supporting the pole and fixture systems being utilized in accordance with specifications.

G. Catalog cuts proving complete conformance to the specifications.

1.6 SYSTEMS PERFORMANCE

A. All luminaire as indicated on the drawings shall be "cut-off luminaire". A "cut-off luminaire" is defined by the following limitations of light distributions:

B. At any lateral angle around the luminaire, the candle power per 1000 lumens shall not exceed 25 lumens at an angle of 90 degrees above horizontal and 100 lumens at a vertical angle 80 degrees above horizontal.

C. All site lighting shall minimize light trespass and spillover onto adjacent properties. Internal house-side shields shall be incorporated on all pole-mounted luminaire abutting adjacent properties.

1.7 WARRANTY

A. Provide Owner with one year warranty certificate signed by Contractor and by the company providing actual warranty labor. This certificate must be received by the Owner prior to final payment.

PART 2 - PRODUCTS

2.1 HIGH INTENSITY DISCHARGE LAMPS (HID)

A. Lamps shall be provided from the following manufacturers or approved equal. The Contractor is responsible that all lamps conform to the site lighting schedule and luminaire manufacturer specifications. If any discrepancies exist, the Contractor shall notify the owner's representative, or Project Landscape Architect.

1. Venture lighting international, 3200 Aurora Road, Solon, OH 44139, Phone: (800) 451-2606.

2. Eye Lighting International of North America, Inc. Phone: (888) 665-2677.

3. Phillips Lighting Company, 200 Franklin Square Drive, P.O. Box 6800, Somerset, NJ 08875-6800, Phone: (800) 555-0050.

4. GE Lighting, Phone (800) GE Lamps.

5. Sylvania, 100 Endicott Street, Danvers, MA, Phone (978) 777-1900.

2.2 DRIVERS FOR LED LAMPS

A. General Requirements

1. LED Engines / Drivers: Comply with UL 1993, UL 8760.

2. Designed for type and quantity of lamps served.

3. Designed for the full light output unless dimmable controls are indicated.

B. Dimmable control shall pulse width modulation or other approved technology.

C. Power Factor: 0.90 or higher unless otherwise indicated.

D. Total Harmonic Distortion: Less than 20 percent.

E. Transient Voltage Protection: IEEE C62.42.1. and IEEE C62.42.2, Category A or better.

F. Interference: Comply with 47 CFR 18, Ch. 1, Subpart b, for regulations concerning the emission of electronic noise.

2.3 LED LAMPS

A. General Requirements

1. Integral LED lamps: Comply with UL 1993, UL 8750.

2. LED packages and LED arrays: Comply with UL 8750.

3. Color temperature as indicated

B. LEDs shall utilize appropriate technology to achieve the indicated color.

C. Average rated life shall be a minimum 50,000 hours unless otherwise indicated.

D. LEDs shall be wired so that a failure of one LED will not adversely affect output of the lamp.

E. Circuitry shall prevent perceptible flicker over the operating voltage range even when in dimmable mode.

F. LED’s shall meet the LM-80 testing criteria as set forth by the Federal Department of Energy

2.4 LED LUMINAIRES

A. Refer to site lighting plan and schedule on contract documents for luminaire locations, additional specifications, accessories, and specific model numbers.

B. LED Light Fixtures shall meet the LM-79 testing criteria as set forth by the Federal Department of Energy.

C. LED Fixtures must have a lighting facts report to confirm efficacy and energy consumption.

D. Integral and remote Emergency Battery pack must be approved by the Light Fixture Manufacturer unless otherwise noted.

E. An L-70 or greater rating shall be published by the manufacturer to confirm expected life/ performance.

2.5 HIGH INTENSITY DISCHARGE LUMINAIRES

A. Refer to site lighting plan and schedule on contract documents for luminaire locations, additional specifications, accessories, and specific model numbers.

2.6 POLES, SUPPORT ARMS AND BRACKETS

A. Poles: Refer to site lighting plan and schedule on contract documents for luminaire locations, additional specifications, accessories, and specific model numbers.

2.7 PRE-CAST CONCRETE FOUNDATIONS

A. Pre-cast concrete light pole foundations shall be supplied by the following manufacturer(s){or approved equal}:

Cromwell Concrete
P.O. Box 99
Cromwell, CT 06416-1429
Phone: (860) 635-5146
Fax: (860) 635-7469

Modern Concrete, Inc.
3900 Clover Road
Easton, PA 18040
Phone: (484) 548-6200
Fax: (610) 258-8165

B. All pre-cast foundations shall be reinforced per the Contract Documents.

2.8 ROUND CONCRETE FORMS

A. Concrete forms shall be supplied by the following manufacturer:

Sonoco Products Company
One North Second Street
Hartsville, SC 29550

B. Sonotube Concrete Forms

1. Description: Multiple layers of 100 percent recycled paperboard, spirally wound, and laminated with adhesive.

2. Interior Surface: Smooth with spiral seam. Alathon release and moisture barrier coating.

3. Exterior Surface: Micryl moisture barrier coating.

4. Spiral Mark: Impact visible spiral mark on concrete columns.

5. 1-piece, 1-time-use forms.

6. Recyclable.

7. Inside Diameter: As indicated on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide concrete base for light poles at location indicated on the construction documents.

B. Install poles plumb. Provide shims or double nuts where necessary to adjust plumb. Grout around each base.

C. Install lamps in each luminaire. Contractor shall exercise caution when handling lamps. Contractor shall avoid handling lamps without clean gloves or a protective cloth wrap.

D. Bond luminaire, metal accessories and metal poles to branch circuit equipment grounding conductor. Provide supplementary grounding electrode at each pole.

3.2 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for improper connections and operation.

B. Measure illumination levels to verify conformance with performance requirements as specified on the construction drawings and/or local ordinances.

C. Take measurements during the night sky, without moon or with heavy overcast clouds effectively obscuring the moon.

D. Aim and adjust luminaire to provide illumination levels and distribution as indicated on the construction drawings or as directed.

3.3 CLEANING

A. Clean electrical parts to remove conductive and deleterious materials.

B. Remove dirt and debris from enclosure.

C. Clean photometric control surfaces as recommended by manufacturer.

D. Clean finishes and touch up damage.

3.4 PROTECTION OF FINISHED WORK

A. Contractor shall protect all work while construction is in progress. Contractor is responsible for any damage incurred during construction.

B. Relamp luminaire which have failed or been damaged during construction at substantial completion.

3.5 TESTING

A. Perform and record voltmeter measurements according to standard testing procedures. In addition, provide labor, material, and energy to conduct a parking lot light test at least 30 days prior to Substantial Completion date. This test shall consist of continuous operation of fixtures and lamps for a time period of 100 hours. Contractor shall witness and certify the continuous operation and time duration of the test. At the end of the testing period, immediately request warranty parts and replace defective components at least three days prior to Substantial Completion date.

END OF SECTION

SECTION 28 31 64 - FIRE ALARM LOCAL BUILDING SYSTEM

PART 1 - GENERAL
[Filed Sub Bid Required]

1.1 GENERAL & FILED SUB BID PROVISIONS

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

B. Payment and Performance Bonds: Filed Subcontractors shall:
   1. Provide Payment and Performance Bonds for the full value of their Subcontract.
   2. Include the full cost of the required bond in their Bid.

C. Eligibility: Bids will be accepted only from Filed Subcontractors with certificates of eligibility from the authorities having jurisdiction.

D. Submitting Filed Sub Bids: Comply with directions of Awarding Authority and the State Statutes and the following:
   1. Comply with the Instructions to Bidders.
   2. Bid forms: Use only identified bid forms, acceptable to Awarding Authority.
   3. Bid bonds: Provide bid bonds as directed in the Instructions to Bidders in the form and manner indicated for 5% the total value of the Bid.
   4. Submit bid in sealed envelope in the manner and before the time and date indicated. On outside of envelope, Include name of Sub Bidder, Project name and number and identified as follows:
      FILED SUBCONTRACTOR'S BID FOR SECTION:
      28 31 64 – Fire Alarm Local Building System

E. Sub-Bid Requirements: Filed Subcontractors shall perform all work of the Sub Bid Contract with employees on the Filed Subcontractor's payroll except, if the Filed Subcontractors proposes to subcontract any work, then the Filed Subcontractors shall identify on the bid form:
   1. All subcontractors to the Filed Subcontractor, whose work is:
      a. Subject to the provisions of MGL Chap. 149, §§ 44A-J.
      b. Valued at $10,000 or more.
   2. The contract sum for each subcontractor required to be listed.
      a. An affidavit that all subcontractors named on the Filed Subcontractors's bid form have been qualified or certified by the Filed Subcontractors using criteria similar to the criteria for the qualification or certification of Filed Subcontractors.
   3. Any sub-subcontracts listed below under Sub-sub Bid Requirements.
   4. Comply with the applicable Mass. General Laws and the following:
      a. Sub bidder's attention is directed to Massachusetts G.L. Chapter 149 Section 44F, as amended, which provides in part as follows.
      b. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part

thereof for which the Section of the Specifications for that sub trade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

5. Sub-sub Bid Requirements: This Filed Subcontractors Sub-Bid requires the following classes of work be listed in the Bid Form:

Class of Work	Specification section number and name
a. None**.**	None.

F. Reference Drawings: The Work of this Trade Bid is shown on the following Contract Drawings:
1. E1.01 – Lighting Plan
2. E2.01 – Power Plan
3. E2.02 – Power Roof Top Plan
4. E3.00 – Electrical Details
5. E4.00- Electrical Notes
6. FA1.01- Fire Alarm Plan

1.2 SUMMARY OF SUB BID CONTRACT

A. Work Includes providing labor, materials and equipment necessary to complete the work of this Section, including but not limited to, all work of the following sections:
1. Section 26 05 00 – Basic Method and Requirements (Electrical)
2. Section 26 05 21 – Cables, Low Voltage (600 Volts and Below)
3. Section 26 05 26 – Grounding
4. Section 26 05 33 – Raceway Systems
5. Section 26 05 41 – Underground Electrical Construction
6. Section 26 22 00 – Low-Voltage Transformers
7. Section 26 24 16 – Panelboards
8. Section 26 27 26 – Wiring Devices
9. Section 26 29 21 – Disconnects (Motor and Circuit)
10. Section 26 32 13 – Engine Generators
11. Section 26 36 23 – Automatic Transfer Switches
12. Section 26 51 00 – Interior Lighting
13. Section 28 31 64 – Fire Alarm Local Building System

B. Alternates: None.

1.3. DESCRIPTION

A. This section of the specifications includes the detailed layout, furnishing, installation, connection and testing of the fire alarm equipment to form a complete coordinated system ready for operation. It shall include, but not be limited to, alarm initiating devices, alarm indicating devices, control panels, auxiliary control devices, annunciators, power supplies, and wiring as shown on the drawings, specified, and required for proper operation.

B. The Fire Alarm system shall comply with requirements of NFPA 72 for local building systems except as modified and supplemented by this specification. The Fire Alarm system components and installation shall also comply with all local codes and requirements, including ADA requirements.

C. The Fire Alarm system shall employ an addressable fire alarm system to notify occupants to evacuate. The system shall be microprocessor based. System operation shall identify the area of the endangered building from which the alarm was initiated. The alarm system shall be electrically supervised.

D. The information shown on the drawings indicates the design and performance intent for the fire alarm system. Final design details, device locations, equipment selections, battery and low voltage circuit calculations, and installation details shall be developed by a NICET certified technician prior to installation. The contractor shall be responsible for making all needed adjustments and submittals required by the local authority having jurisdiction.

1.4. RELATED WORK

A. Section 26 05 00, BASIC METHODS AND REQUIREMENTS (ELECTRICAL)

B. Section 26 05 33, CONDUIT SYSTEMS

C. Section 26 05 21, CABLES, LOW VOLTAGE (600 VOLTS AND BELOW)

1.5. SUBMITTALS

A. Initial Submittal

1. Submit sufficient information, clearly presented, to demonstrate compliance with the drawings, specifications, and code requirements.
2. Include ratings, power requirements, dimensions, mounting, equipment, device arrangement, complete wiring diagrams (including floor plans), connection diagrams with terminal identification, material, and description of operation
3. Manufacturer's descriptive data sheets clearly identifying each component shall be provided.
4. Show annunciator layout, codes, riser diagram, and auxiliary functions.
5. Complete backup calculations shall be provided in conformance with NFPA 72 for the FACP and all subsystems utilized for notification and fire department communications.

B. At completion of project submit the following:

1. Complete operating and maintenance manuals including technical data sheets, wiring diagrams, and information for ordering replacement parts.
   a. Wiring diagrams shall have their terminals identified to facilitate installation, operation and maintenance.
   b. Wiring diagrams shall indicate internal wiring for each item of equipment and the interconnections between the items of equipment.
   c. Provide a clear and concise description of operation which gives, in detail, the information required to properly operate the equipment and system.
2. Two weeks prior to final inspection, deliver four copies of the final updated operating and maintenance manual to the Engineer.
   a. The manual shall be updated to include any information necessitated by shop drawing approval.
   b. Complete "As installed" wiring and schematic diagrams shall be included which show all items of equipment and their interconnecting wiring.
   c. Show all terminal identification.
   d. Include information for testing, repair, trouble shooting, assembly, disassembly, and recommended maintenance intervals.
   e. Furnish manuals in loose leaf binder or manufacturer's standard binder.

C. Certifications:

1. Provide certification from both the major equipment manufacturer and the detector manufacturer that the detectors being furnished are listed by UL as being compatible with the control equipment.

1.6. APPLICABLE PUBLICATIONS

The publications listed below form a part of this specification to the extent referenced. The publications are referenced in text by the basic designation only.

A. National Fire Protection Association (NFPA):

70 National Electrical Code (NEC)

72 National Fire Alarm Code

B. Underwriters Laboratories, Inc. (UL):

50 Safety Enclosures for Electrical Equipment

268 Smoke Detectors for Fire Protective Signaling Systems; 864
Control Units for Fire Protective Signaling Systems;

PART 2. PRODUCTS

2.1. EQUIPMENT AND MATERIAL, GENERAL

All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by Underwriters Laboratories, Inc., or Factory Mutual Research Corporation. An authorized representative of the manufacturer of the major equipment such as control panel, annunciator, transmitters, and initiating devices, shall install and be responsible for satisfactory total system operation and its certification. All equipment shall include a warranty of one year from date of final inspection and acceptance by local authorities.

2.2. WIRING

A. Wiring shall be in accordance with NEC, as shown on the drawings, and as recommended by the manufacturer of the fire alarm system. All wires shall be color coded. Number and size

of conductors shall be as recommended by the fire alarm system manufacturer but not less than 18 AWG. Wiring shall be FPLP unless noted otherwise.

B. Wires in junction boxes and cabinets shall be permanently tagged and identified with metal or phenolic tags attached by nylon ties.

C. Terminal Boxes, Junction Boxes and Cabinets:

1. Shall be steel and in accordance with UL.
2. Paint box and cover red and identify with letters of white paint stenciled as "Fire Alarm System"
3. Junction boxes shall have a volume 40 percent greater than required by the NEC. Minimum sized wire shall be considered as 14 AWG for calculation purposes.

2.3. NOTIFICATION DEVICES (HORNS AND STROBES)

A. The notification devices shall consist of combination electronic horn/strobes or stand-alone strobes as indicated on the drawings.

B. The electronic horns shall be capable of an output of at least 85-dB sound pressure level at 10 ft. and shall be capable of producing a code 3 temporal pattern upon activation of the notification circuits (operating at a steady 24 volts DC). The horns shall be designed such that the code 3 temporal pattern is synchronized between all operating horns of the system.

C. Strobe circuits shall be coordinated with audible circuits such that activation of an audible circuit results in activation of the companion strobe circuit. The strobe circuits shall be capable of being arranged such that they continue to operate in the event that the audible circuits have been silenced and remain operating until the FACP has been reset. Strobe circuits should also be coordinated with the audible circuits such that they are zoned in the same manner as the audible circuits.

D. All stand-alone strobes as well as strobe devices of combination electronic horn/strobes shall be rated as indicated on the drawings or as required by NFPA 72. Both the audible circuits and the strobe circuits shall be designed for expandability. The maximum load per circuit shall not exceed 80 percent of circuit capacity. The installing contractor is responsible for assuring that the strobe circuit capacity contemplates the inherent momentary current surge of the strobe devices.

E. Activation of any alarm initiating devices shall cause the following to occur:

1. Indicators within the FACP shall activate an integral alphanumeric or LED display within the FACP as well as the remote LCD annunciator panel shall provide identification of the exact initiating device or zone in alarm.
2. Refer to drawings for matrix of operations
3. All notification devices of the system shall operate such that all occupants of the building are notified.
4. Activation of individual duct detectors shall result in automatic shutdown of the respective air handling units. In general, duct-type smoke detectors shall not activate building notification devices unless specifically identified to do so.
5. Refer to drawings for requirements for initiating devices associated with the elevator control system (if present).

F. Refer to drawings for requirements for initiating devices associated with the fire protection sprinkler system (if present). As a minimum NFPA required monitoring shall be provided for projects with sprinkler systems. Contractor shall coordinate detailed requirements with local fire marshal.

2.4. MANUAL STATIONS

A. Shall be non-breakglass, non coded type.

B. Station front shall be of cast or extruded metal. Stations shall be semi flush type, unless otherwise shown on the drawings. Stations shall be installed not more than 1200 mm (48 inches) from finished floor to center line of device.

C. Stations shall be of the single action pull down type with suitable operating instructions provided on front in raised or depressed letters.

D. Unless otherwise specified, all exposed metal parts shall be anodized, or given a prime coat and one or more finishing coats of red lacquer or red enamel to provide a smooth, hard, durable finish. Other approved equivalent finish with red lettering is acceptable.

E. Operating handles shall be metal. On operation, the lever shall lock in alarm position and remain so until reset. A key or wrench shall be required to gain access for resetting, or conducting tests or drills. Gravity, mercury, or other switches which may be tripped by

vibration or jarring are not acceptable. Unit shall be furnished with terminal blocks clearly marked to indicate connections.

2.5. INITIATING DEVICES (SMOKE AND HEAT DETECTORS)

A. Smoke detectors shall be photoelectric system type, complying with applicable UL standards. Install in accordance with the manufacturer's recommendation and NFPA 72. All detectors shall have an insect screen. Detectors shall have an indicator to denote an alarm condition

B. Photoelectric detectors shall be factory calibrated. The sensitivity of any photoelectric detector shall be factory set at 3.2 percent plus or minus 0.5 percent obscuration per foot. These detectors shall be mounted as required for detection of the particles of combustion at the installed location without causing nuisance activation.

C. Duct detectors shall be listed and labeled for duct installation. See the mechanical drawings for locations of duct detectors. Detectors shall be provided with an approved duct housing mounted exterior to the duct, and shall have perforated sampling tubes extending across the full width of the duct (wall to wall). Duct detectors whose operation requires the heads to be mounted inside of ducts are not acceptable. Interlocking with fans shall be provided as specified in PART 3 under Article, TYPICAL OPERATION. Provide remote indicator and identification nameplates (smoke detector) for smoke detectors concealed from normal view. Duct smoke detectors shall be capable of remote resetting.

D. Heat Detectors shall be installed where shown on the drawings. The thermal type sensor shall be a plug-in unit which mounts to a twist-lock base. The sensor shall be a combination rate of rise/fixed temperature sensor U.L. Listed/FM approved as a rate compensated heat detector. Each sensor shall be capable of operating at a selectable rate of rise operation of 15 or 20 degrees Fahrenheit per minute and shall be self-restorable. Each sensor is capable of fixed temperature operation selectable for either 117 or 135 degrees Fahrenheit, independent of the rate of rise setting. The 135-degree F. setting shall be used.

E. Guaranteed simultaneous operation: Detector power supply shall be such that guaranteed simultaneous operation of all detectors shall result in alarm reporting and detector function of all detectors without losing any detector signal.

F. Control and power panels necessary for operation of smoke detectors shall be provided as individual units, or integral with the fire alarm control panel. Detectors and associated

panels must be compatible with the fire alarm control panel and suitable for use in supervised circuits. Detectors must be capable of functioning upon loss of normal AC system operating power and all necessary equipment and devices to permit such operation shall be provided. Malfunction of the circuitry to the detector or its control, or power units shall result in operation of the system trouble devices. Reset of detectors, after alarm, shall be from the fire alarm control panel.

G. In addition to the items specified, provide all items necessary for satisfactory operation of the detector installation.

2.6. WATERFLOW SWITCHES (when building has sprinkler system)

A. Each sprinkler system zone or riser shall be equipped with integral, mechanical, non coded, non accumulative retard type water flow switch. Each switch shall also have an SPDT auxiliary contact.

B. Switches shall be conveniently adjustable from 0 to 60 seconds.

C. Flow switches shall be provided and connected as part of this fire alarm system.

2.7. SPRINKLER AND STANDPIPE VALVE SUPERVISORY SWITCHES

A. Each sprinkler system riser or zone control valve, and each standpipe system riser OS&Y control valve shall be equipped with a supervisory switch. Standpipe hose valves and test and drain valves shall not be equipped with switches.

B. PIV (post indicator valve) or main gate valve shall be equipped with a supervisory switch.

C. Mount switch so as not to interfere with the normal operation of the valve and adjust to operate within two revolutions toward the closed position of the valve control, or when the stem has moved no more than one fifth of the distance from its normal position.

D. The mechanism shall be contained in a weatherproof die cast aluminum housing, which shall provide a 19 mm (3/4 inch) tapped conduit entrance and incorporate the necessary facilities for attachment to the valves.

E. Switch housing to be finished in red baked enamel.

F. The entire installed assembly shall be UL or Factory Mutual approved; tamperproof and arranged to cause a switch operation if the housing cover is removed, or if the unit is removed from its mounting.

2.8. ELECTROMAGNETIC DOOR HOLDERS

A. Door holders shall be provided (if required) as shown the drawings, connected and coordinated into the fire alarm system as specified in this section.

B. Operation shall be by 24 volt DC supplied from a battery located at the fire alarm control panel. Coordinate door holders as to voltage, ampere drain, and voltage drop with the battery, battery charger, wiring, and fire alarm system for the operation specified.

C. A maximum of eight door holders shall be provided for each circuit with its own fuses, disconnect switch and pilot light.

D. Associated relay control circuits shall be electrically supervised.

E. Smoke detectors shall not be incorporated as an integral part of door holders, but are functionally associated as hereinafter specified.

F. Provide master control switches with pilot light, for maintaining power to door holders during fire alarm tests. A switch shall be located at the fire alarm control panel.

2.9. ANNUNCIATOR PANELS

A. Shall be installed in UL listed.

B. Flush mount cabinets at location designated by local authority having jurisdiction.

C. Components shall be arranged to facilitate convenient operation, testing, and maintenance from the front.

D. Identification Devices Shall display English-language text of system point information including device type, zone, independent point alarm, trouble or supervisory status, as well as any custom banners programmed into the control panel.

E. Display shall incorporate backlit LCD characters (minimum 20 characters x 4 lines).

2.10. FIRE ALARM CONTROL PANEL

A. Function:

1. Operate as a supervised, coded, positive noninterfering successive alarm system.
2. Supervise all signal initiating circuits, alarm indicating circuits, alarm transmitter trip circuits, and sprinkler and standpipe valves.
3. Detect the operation of any signal initiating device and the area of the alarm condition, and operate all alarm and designated auxiliary devices.
4. Visually and audibly annunciate any trouble condition such as main power failure, ground or system wiring derangement, and sprinkler system and standpipe valve off normal position.

B. Enclosure:

1. The control panel shall be housed in a cabinet suitable for surface mounting. Cabinet and front shall be corrosion protected, given a rust resistant prime coat, and manufacturer's standard finish.
2. Cabinet shall contain all necessary components, relays, terminals, indicating devices and displays to provide control for the system.

C. Power Supply:

1. The control panel shall derive its normal power from a 120 volt, 60 Hz supply. Standby power shall be provided by a DC battery as recommended by the manufacturer. The normal power shall be transformed, rectified, coordinated, and interfaced with the standby battery and charger.
2. The door holder power shall be arranged so that momentary or sustained loss of main operating power shall not cause the release of any door. This may be accomplished by floating the door holders across the battery supply or by other approved means accomplishing the same function.
3. Power supply for smoke detectors shall be taken from the fire alarm control panel.
4. Provide protectors to protect the fire alarm equipment from damage due to lightning or voltage and current transients.

D. Circuit Arrangement:

1. Alarm initiating circuits shall be of the low voltage type and arranged for operation from normally open contact devices. Monitoring of addressable components may also be used.
2. Provide means whereby any initiating zone or annunciator circuit may be disconnected from the system. Removing any zone or annunciator circuit shall leave the remainder of the system in normal operating condition, and activate an individual trouble signal which shall remain activated until the circuit is restored to normal operating condition.
3. Arrange circuits so that if an open circuit occurs in an indicating device, it shall not prevent other signals on the same circuit from activating.
4. Each circuit shall be individually protected.

E. Circuit Supervision:

1. Each alarm initiating circuit, alarm indicating circuit, and local energy transmitter trip circuit, and sprinkler and standpipe valve circuit shall be supervised against the occurrence of a break or ground fault condition in the field wiring. These conditions shall cause a trouble signal to sound in the control panel until manually silenced by an off switch.
2. Sprinkler system valves, standpipe control valves, PIV, and main gate valves shall also be supervised for off normal position. Valve supervision shall indicate the fire alarm zone in which the valve is located. Supervisory switches may be series connected in the zone alarm initiating circuit after the last device on the circuit. Closing a valve shall sound a trouble signal in the control panel until silenced by an off switch. Valve operation shall not cause an alarm signal.
3. Each circuit shall have individual trouble indicators (amber) and alarm indicators (red).

F. Trouble signals:

1. Arrange the trouble circuit for ring back operation to prevent switch disarrangement during normal supervisory condition. Automatic reset arrangement is acceptable in lieu of ring back operation.
2. System trouble switch off and on indicators shall be visible through the control panel door.

G. Modules:

1. Module assemblies shall be of unit type construction and mounted on channels to permit easy removal and service by circuit function.
2. Modules shall contain system fault locators to enable maintenance personnel to pinpoint individual fault conditions.
3. Each module shall contain alarm indicators to indicate which zone or addressed device is in alarm.
4. Modules shall have provisions for relaying incoming zone alarms to a display on a remote annunciator and perform auxiliary functions. Modules shall discriminate an incoming zone alarm as to category (manual alarm; smoke alarm; waterflow alarm) and indicate the signal at the remote annunciator as to location and category.
5. Each initiative alarm circuit shall have its own control module.

H. Printed Circuit Boards: Shall be of easily removable type and have sufficient capacity for the circuits controlled.

I. Auxiliary Control Capability: The control panel shall perform auxiliary control functions on a common or selective basis as required. Auxiliary control capability includes such functions as HVAC shutdown and elevator recall. Coordinate requirements with HVAC and elevator installers.

J. Function Switches: Provide the following switches in addition to any other switches required for the system.

1. Master Building Transmitter Switch: Shall prevent tripping of alarm transmitter when in off position. System trouble alarm shall be energized when switch is in off position.
2. Alarm Off Switch: Shall disconnect power to alarm indicating device circuits. System trouble alarm shall be energized when switch is in off position.
3. Trouble Off Switch: Shall silence the trouble signal whenever the system trouble circuit is energized.
4. Reset Switch: Shall reset the system after an alarm, provided the initiating device has been reset. The system shall lock in until reset.
5. Test Switches: A test switch or other approved convenient means shall be provided to test the indicator lamps.
6. Drill Switch: Shall sound the alarm indicating devices without tripping the alarm transmitter.
7. Master Door Release Switch: Shall prevent doors from releasing during fire alarm tests.
8. A visual indicator shall show the off normal condition.

K. Remote Transmissions:

1. Provide local energy trip circuits as required.
2. The system shall be capable of operating a local energy fire alarm transmitter or telephone dialer for automatically transmitting fire information to the fire department.
3. Transmitters shall be compatible with the systems and equipment they are connected to such as timing, operation and other required features.

L. System Expansion: Design the control panel so that the system can be expanded in the future (to include the addition of twenty percent more circuits or zones) without disruption or replacement of the existing control panel.

2.11. BATTERY AND CHARGER

A. Battery:

1. Shall be of nickel cadmium.
2. Battery shall have sufficient capacity to power the fire alarm system for not less than twenty four hours plus five minutes of alarm to an end voltage of 1.14 volts per cell, upon a normal AC power failure. System load shall include the power required by the electromagnetic door holders.
3. Battery racks shall be steel with an alkali resistant finish.

B. Battery Charger:

1. Shall be completely automatic, with constant potential charger maintaining the battery fully charged under all service conditions. Charger shall operate from a 120 volt, 60 hertz source.
2. Shall be rated for fully charging a completely discharged battery within 48 hours while simultaneously supplying any loads connected to the battery.
3. Shall have protection to prevent discharge through the charger.
4. Shall have protection for overloads and short circuits on both AC and DC sides.
5. A trouble condition shall actuate the fire alarm trouble signal.
6. Charger shall have automatic AC line voltage regulation, automatic current limiting features, and adjustable voltage controls.

PART 3. EXECUTION

3.1. INSTALLATION

A. Installation shall be in accordance with the NEC, NFPA 72, based upon the locations shown on the drawings, and as identified by the documents approved by the local authority having jurisdiction. Final system details, locations, and installation requirements shall be as developed by a NICET certified technician and as recommended by the component manufacturers.

B. All work performed to comply with this specification shall be carried out by and/or managed by a competent firm regularly engaged in the installation and testing of fire alarm systems for commercial buildings. All subcontractors of the contractor including the chosen fire alarm equipment distributor shall also be competent firms which are regularly engaged in the design, installation, testing, and servicing of fire alarm systems for commercial buildings.

C. Install smoke detector heads not more than two weeks prior to final inspection. Test the detectors in place.

D. At the final inspection a factory trained representative of the manufacturer of the major equipment shall perform the tests in Article 3.3. Tests. The representative shall demonstrate that the system functions properly in every respect in the presence of an owner's representative.

3.2. TYPICAL OPERATION

A. Normal System Operation: Refer to FACP Matrix on the drawings. Actuation of any manual station, smoke detector, heat detector, or water flow switch shall cause the following operations to occur, unless otherwise specified:

1. Operate the audible signals in the building.
2. Flash strobe lights. Lights shall continue to flash until reset at the fire alarm control panel.
3. Activate the associated location and type indicators on the remote annunciator panel and the control panel.
4. Release all magnetic door holders on the floor from which alarm was initiated.
5. Transmit a separate code alarm signal, via a telephone transmitter to the owner's designated monitoring service

6. Smoke detectors in elevator lobbies shall, in addition to the above functions, cause the elevator cars in the related bank to return to an assigned floor (see elevator section of specifications and drawings for details and operation).
7. Duct type smoke detectors and waterflow switches shall, in addition to A.1. through A.6. above, perform the functions specified in the mechanical specifications or shown on the mechanical drawings.
8. Operation of any sprinkler and standpipe valve supervisory switch shall cause the system to go into trouble condition.
   a. It shall not cause the system to go into alarm condition.
   b. It shall not prevent any flow switch from actuating an alarm.
9. Cooking Equipment Fire Extinguishing Connection shall, in addition to the above, perform the functions specified in the mechanical specifications or shown on the mechanical drawings, including fuel source cut-off.

B. System Supervision: System supervision shall include the following conditions:
   1. Loss of operating or standby power.
   2. A single ground or open circuit in alarm initiating circuits, alarm indicating circuits, and sprinkler and standpipe valve circuits. Each circuit shall have its own supervisory devices.
   3. Off normal position of sprinkler and standpipe valves.
   4. Battery and battery charger shall have supervision as specified elsewhere in this section.

C. Trouble Signals:

   1. Derangement of any of the above supervised conditions shall be visually and audibly annunciated at the fire alarm control panel. Each device, circuit, or zone shall have individual visual annunciation.
   2. Operation of the sprinkler and standpipe valves towards the closed position shall cause a trouble signal.
   3. Trouble signals shall be retransmitted to the remote monitoring service identified by the owner

3.3. TESTS

A. Provide the service of a competent authorized engineer or technician authorized by the manufacturer of the fire alarm equipment to supervise and participate during all of the adjustments and tests for the system

B. When the systems have been completed and prior to the scheduling of the final inspection, furnish testing equipment and perform the following tests. When any defects are detected, make repairs or install replacement components, and repeat the tests until such time that the complete fire alarm system meets all contract requirements.

1. Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
2. Test the insulation on all installed cable and wiring by standard methods as recommended by the equipment manufacturer.
3. Run water through all flow switches. Drain the water by hose to the nearest drain. Check to verify whether all codes are coming in clearly and correctly. Check time delay on water flow switches to assure that water surges do not trip transmitters. (Submit a report listing all water flow switch operations and their retard time in seconds.)
4. Open fire alarm station circuits to see if trouble signal actuates.
5. Open audible signal circuits to see if the trouble signal actuates.
6. Ground fire alarm station circuits and verify response of trouble signals.
7. Ground audible signal circuits and verify response of trouble signals.
8. Check code transmission of all fire alarm devices and verify proper operation of positive noninterfering succession requirements by operating two fire alarm stations simultaneously.
9. Check installation, supervision, operation and sensitivity of smoke detectors to ascertain that they will avoid false alarm signals and will function as specified. See Article, SMOKE DETECTORS.

3.4. FINAL INSPECTION

A. At the final inspection a factory trained representative of the manufacturer of the major equipment shall perform the tests in Article 3.3 TESTS. In addition the representative shall demonstrate that the systems function properly in every respect. Perform all tests as required for approval by the local inspection authority.

3.5. INSTRUCTION

A. Furnish the services of a competent instructor for instructing personnel in the operation and maintenance of the system.

END OF SECTION

SECTION 31 00 00 - EARTHWORK

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.

B. Work governed by this section, as shown or specified shall be in accordance with the requirements of the Contract Documents and the New York State Building Code (International Building Code 2018 edition).

1.2 SUMMARY

A. This Section includes the following:
1. Removal of existing pavements, curbs, abandoned pipes, retaining walls, utilities, former foundation structures, and other structures encountered which require removal for successful completion of the Work.
2. General excavation to levels established within the Contract Drawings and as described herein.
3. Local excavation for the footings, slabs, walls, and other foundation elements indicated on the Contract Drawings and as directed by the Owner's Engineer.
4. Excavation, fill placement, grading and compaction to required elevations for appurtenances and general site work as shown on the Contract Drawings and as directed herein.
5. Excavation, trenching and backfilling for mechanical trades, including but not limited to plumbing, heating, water, steam, gas, and electric within and outside the site as shown on the Contract Drawings or as required to make the work complete; backfilling same with suitable fill materials as described herein; and thoroughly compacting said materials to "Rough Grading" elevations.
6. Excavation, trenching, and backfilling for temporary works as shown or as required; backfilling same with approved fill; compacted and rough grading.
7. Improvement of subgrade conditions via the removal and replacement program as outlined on the project's geotechnical report, and placement of approved fill as directed by the Owner's Engineer.
8. Preparing subgrades for walks, pavements, utility structures, stormwater management and bioretention basins, lawns, and plantings.
9. Subbase course for concrete walks and pavements.
10. Excavating and backfilling utility trenches.
11. Excavating and backfilling for structural foundations.
12. Disposal of unsuitable material.
13. Disposal of surplus suitable material, if required.

14. Protection of adjacent structures, utilities, and pavements.
15. Temporary groundwater control as required for execution of the Work for this Section and for all other related foundation Work.
16. All other labor equipment, and materials as may be reasonably inferred to be required to make the Work under this Section complete.

B. Related Sections include the following:
1. Section 311000 – Site Clearing.
2. Section 312513 – Erosion and Sediment Control.
3. Section 331101 – Water Utility Distribution Piping.
4. Section 331216 – Water Utility Distribution Valves.
5. Section 333104 – Sanitary Sewer Pipe.
6. Section 333901 – Sanitary Sewer Structures.
7. Section 333913 – Storm Drainage Structures.
8. Section 334105 – Storm Drainage Piping.

1.3 REFERENCES

A. New York State Department of Transportation (NYSDOT) September 1, 2021 Standard Specifications.

B. All Work under this Section shall conform to the most restrictive requirements of the New York State Building Code (IBC 2018 edition), and to the regulations of all governmental authorities having jurisdiction.

C. New York State Department of Environmental Conservation (NYSDEC) "New York State Standards and Specifications for Erosion and Sediment Control, latest edition (a.k.a. Blue Book).

D. Occupational Safety and Health Administration (OSHA) Excavation Regulations, latest edition.

E. American Society for Testing and Materials (ASTM)
1. ASTM C-33 Standard Specifications for Concrete Aggregates.
2. ASTM D-422 Standard Test Method for Particle Size Analysis of Soils (sieve only).
3. ASTM D-2216 Test Method for Laboratory Determination of Water (Moisture) Content of Rock and Soil.
4. ASTM D-4318 Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
5. ASTM D-448: Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
6. ASTM D-698: Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600kN-m/m3)).
7. ASTM D-1556 – Standard Test Method for Density and Unit weight of Soil in Place by the Sand-Cone Method
8. ASTM D-1557: Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

9. ASTM D-2167 - Standard Test Method for Density and Unit weight of Soil in Place by the Rubber Balloon Method.
10. ASTM D-2487: Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
11. ASTM D-2940: Standard Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports.
12. ASTM D-6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

F. ACI-318 – Building Code Requirements for Structural Concrete, latest edition.

G. ACI-299R – Controlled Low Strength Materials, latest edition.

H. Geotechnical Report: A Geotechnical Engineer engaged by the Owner has prepared a report entitled Report, Geotechnical Investigation, Proposed Animal Shelter, Pomona, Rockland County, New York, prepared by Melick-Tully & Associates, dated September 14, 2021. A copy of the report shall be available to the Contractor for reference. Boring and other in situ test logs are made available to the Contractor for information only. Conditions are not intended as representations or warranties of accuracy or continuity between borings. The Owner will not be responsible for interpretation conclusions drawn from this data by the Contractor.

1.4 DEFINITIONS

A. Backfill: Soil materials used to fill trench, structure or pit excavations.
1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course/Binder Course: Layer placed between the subbase course and bituminous concrete paving.

C. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.

D. Bituminous Concrete Paving Course: Layer of bituminous concrete paving placed above the base/binder course.

E. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

F. Cohesive Materials: Cohesive materials include materials classified by ASTM D2487 as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesive only when fines have a plasticity index greater than zero.

G. Cohesionless Materials: Cohesionless materials include materials classified by ASTM D2487 as GW, GP, SW, and SP. Materials classified as GM and SM will be identified as cohesionless only when the fines have a plasticity index of zero.

H. Compaction: The process of mechanically stabilizing a material by increasing its density at a controlled moisture condition. "Degree of Compaction" is expressed as a percentage of the maximum density obtained by the test procedure described in ASTM D1557 for general soil types abbreviated in this specification as 95 percent ASTM D1557 maximum density.

I. Crushed Stone: Natural, non-friable crushed material used for drainage and granular backfill.

J. Drainage Fill: Clean, poorly graded crushed rock, stone, or natural sand or gravel having a high porosity which is placed beneath a building slab or adjacent to structures with or without a vapor barrier to cut off the capillary flow of pore water and provide free drainage to the area immediately below a slab or adjacent to structures.

K. Embankment: The portion of a fill section situated between the embankment foundation and the subgrade surface, excluding any material placed under another section of these specifications.

L. Engineered Fill/Structural Fill/Select Fill: Soil materials used to raise existing grades and placed under controlled conditions.

M. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

N. Hard Material: Weathered rock, dense consolidated deposits or conglomerate materials which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment with ripper teeth or the use or jack hammers for removal.

O. Lift: A layer (or course) of soil placed on top of a previously prepared or placed soil in a fill or embankment.

P. Rock: Limestone, Sandstone, Shale, Granite and similar material in solid beds or masses in its original or stratified position which can be removed only by blasting operations, drilling, wedging, or use of pneumatic tools.

Q. Soil: The loose surface material of the earth's crust resulting from the chemical and mechanical weathering of rock and organic material. Materials free from debris, roots, wood, scrap materials, vegetative matter, refuse or frozen material. Maximum particle size permitted is 3 inches. Use excavated material from the site for the work indicated when material falls within the requirements specified herein.

R. Stabilized Sub-grade: A layer of compacted crushed stone that replaces the in-place existing material to provide a stable, uniform bearing foundation for further construction.

S. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

T. Subbase Course: Layer or layers placed between the subgrade and base course for bituminous concrete paving, or layer placed between the subgrade and a concrete pavement or walk.

U. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

V. Topsoil: In natural or undisturbed soil formations, the fine-grained, weathered material on the surface or directly below any loose or partially decomposed organic matter. Topsoil may be a dark-colored, fine, silty, or sandy material with a high content of well decomposed organic matter, often containing traces of the parent rock material. Gradation and material requirements specified herein apply to all topsoil references in this contract. The material shall be representative of productive soils in the vicinity.

W. Unsatisfactory Material: Existing, in-place soil or other material which can be identified as having insufficient strength characteristics or stability to carry intended loads in fill or embankment without excessive consolidation or loss of stability. Unsatisfactory materials also include manmade fills, refuses, frozen material, un-compacted backfills for previous construction, unsound rock or soil lenses, or other deleterious or objectionable material.

X. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within structures.

Y. Unclassified Excavation: Unclassified excavation shall consist of the excavation and disposal of all materials, of any description, encountered in the course of construction, unless otherwise specified in the contract. Estimated limits and descriptions of subsurface deposits and formations which may be shown in the contract documents are supplied as part of Base Line Data.

Z. Filter and Stabilization Fabric: Nonwoven geotextiles consisting of polypropylene fibers having an apparent opening size (AOS) of the U.S. Sieve size 70, and meets AASHTO M288-15 Class 2 for Elongation > 50%. Mirafi 160N or approved equal.

AA. Geotextile: Woven geotextiles consisting of high-Tenacity polypropylene yarns having an apparent opening size (AOS) of the U.S. Sieve size 30. Mirafi HP570 or approved equal.

1.5 SUBMITTAL

A. Materials Source: Submit name of imported materials source.

B. Material Test Reports: For each soil material proposed for fill and backfill.

1. From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated. Prepare separate reports for each type and application of borrow material.
    a. Classification according to ASTM D-2487.
    b. Laboratory compaction curve according to ASTM D-1557.
    c. Moisture content in accordance with ASTM D-2216
    d. Origin of material.
    e. Classification and laboratory compaction curve for on-site soil material, in accordance with the above requirements, when requested by the Owner's Engineer.

C. Product Data: Submit gradation, maximum wash loss, minimum durability index, maximum abrasion loss, air voids.

D. Manufacturer's product data, specifications, installation instructions, product samples for waterproofing and drainage panel proposed for use.

E. Samples:
1. Where requested, the Contractor shall submit samples of materials proposed for use as fill, including, but not limited to general fill, drainage fill, structural fill, pavement subbase course, etc. Samples shall be submitted at least 1 week prior to proposed use on site. Test reports as required under Section 1.5.B shall accompany each sample

F. Submit mix designs, vendor information, materials test data and reports and any other pertinent product data for all proposed concrete fill including but not limited to: structural concrete, lean concrete, and controlled low strength materials (CLSM). All concrete fill mix designs shall be prepared by a Professional Engineer, licensed in New York State.

G. Shop Drawings: Submit detailed shop drawings and calculations to be reviewed by the Owner's Engineer. The drawings and calculations shall be prepared by a Professional Engineer registered in the State of New York. The submittals shall include but not limited to following:
1. Earth excavation procedures.
2. Temporary excavation support where required by field conditions. Submit shop drawings, manufacturer's literature, and engineering calculations, and show and describe proposed excavation support system, general arrangement and sequencing procedures to be used, method of installation, materials, equipment, and emergency action plans.
3. Temporary dewatering procedures where required by field conditions. Submit shop drawings, manufacturer's literature, and engineering calculations, and show and describe proposed groundwater control system, general arrangement procedures to be used, method of installation, materials, equipment, methods of treatment and disposal of pumped water, emergency action plans, and procedures for deactivating the system.
4. Fill materials, equipment, and procedures for placement and methods of compaction, where required.

H. Catalog Cuts: Submit catalog cuts and manufacturer's literature for all compaction equipment, vapor barriers, geosynthetics, and drainage materials including composite sheets and piping.

I. Samples: Submit a 12-inch by 12-inch sample of each geotextile filter fabric, geogrid, and drainage panel proposed for use. Submit a 12-inch-long sample of the proposed drainage pipe.

J. All required certifications and permits pertaining to the work of this Section.

K. Certification for Examination of Site and Records: Before proceeding with the Work, submit certification in an acceptable form, signed by the Contractor, stating that careful examination has been made of the site, existing structures, existing adjacent structures, records of utility lines, test boring records, soil samples, subsurface exploration reports, the Contract Drawings, and all other Contract Documents.

L. Substitutions: Should the Contractor desire a substitution from the Contract Drawings or specifications, or both, Contractor shall submit the specific substitution in writing prior to submittal of Shop Drawings. Requests for substitutions shall be submitted on the Contractor's letterhead. Approval of the Contractor's request for substitutions shall be at the discretion of the Owner and Owner's Structural and Geotechnical Engineers. Rejection of substitutions shall not be grounds for an adjustment to the Contract price.

1.6 QUALITY ASSURANCE

A. Materials and work shall conform to the latest edition of reference standards specified herein and to applicable codes and requirements of local authorities having jurisdiction.

B. Contractor Qualifications.
   1. The Contractor performing the work of this Section shall be a qualified excavation contractor with at least 5 years of relevant field experience on projects of similar size, scope, and complexity.

C. Work of this Section, as shown or specified, shall be in accordance with the Site Management Plan.

1.7 QUALITY CONTROL – INSPECTION AND TESTING

A. Special Inspection
   1. The Owner will engage, under the requirements of Section 1704.2 of the Building Code, one or more Special Inspection Agencies to observe and provide all necessary material testing related to the work of this Section. All inspections and all materials testing shall be performed by Special Inspectors meeting the minimum qualifications outlined in Section 1704.2.1 of the Building Code.
   2. The Special Inspector shall prepare and submit daily reports summarizing the construction and/or material testing activities. Reports shall include descriptions and sketches of the

work performed to clearly document plan location(s) and elevation(s) of any excavations, fill placement, and testing performed.

3. The Special Inspector shall submit all logs and test reports necessary to facilitate any corrective design requirements by the Engineer of Record.
4. Where work is observed to be non-conforming, the Special Inspector shall immediately inform the Construction Manager and Owner's Engineer(s) of such conditions in writing. A summary of the observed non-conformance shall be issued within 24-hrs. The Special Inspector shall maintain a tracking log of all non-conformances and shall update the tacking log on a daily basis such that corrective measures, if required, can be facilitated in timely fashion. The tracking log shall include such information as ID number, date opened, description of non-conformance, actions required, actions taken, and date closed.
5. The Special Inspector shall provide all necessary certifications of the work in compliance with Building Code requirements.

B. The Special Inspector(s) shall be provided with reasonable office space (heating, cooling, electric) on-site by the Construction Manager to conveniently prepare and maintain all necessary project records pertinent to their duties and to store equipment. At a minimum the Special Inspector shall be provided with a minimum of one desk, a locking cabinet or closet, and wireless internet access.

C. The Contractor shall have the sole responsibility for coordinating his work with the Construction Manager to assure that all tests and inspection procedures required by the Contract Documents and the governing Building Codes are properly provided by the Special Inspector. The Contractor shall cooperate fully with the Special Inspector in the performance of his work.

D. Materials and installed work may require testing at any time as work progresses. Allow free access to material stockpiles and facilities. Tests not specifically indicated herein may be performed at Owner's expense, as required by the Special Inspector.

E. Retesting of rejected materials and installed work shall be Contractor's responsibility and shall be performed at his expense.

F. The Contractor shall notify the Construction Manager and all other necessary parties at least 72 hours prior to each day of required inspection to allow for the appropriate personnel to be on the site.

G. The role of the Special Inspector(s) shall not relieve the Contractor from any responsibility with respect to conformance to the proper workmanship, management of materials and waste, or any other requirements of the Contract Documents.

1.8 PRECONSTRUCTION MEETING

A. Prior to work on site, the Construction Manager will arrange a series of meetings to discuss coordination and scheduling. Parties to be present: Structural Engineer, Geotechnical Engineer, Civil Engineer, Architect, Testing Laboratory, Construction Manager, Excavation Contractor and

his Engineer, the Special Inspector, and the Owner. Review the earthwork procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least 3 working days prior to convening conference. Record discussions and agreements and furnish a copy to each participant.

1.9 DELIVERY AND STORAGE

A. Deliver and store materials in a manner to prevent contamination or segregation. Store synthetic fiber filter cloth to prevent exposure to direct sunlight in accordance with the manufacturer's recommendations.

1.10 PROJECT CONDITIONS

A. Contact “Dig Safe New York” at 1-800-962-7962 before excavating. Proceed with excavation only after utility locator service completes marking of utility locations.

B. Site Information: Subsurface conditions are not intended as representations or warranties of accuracy or continuity. The Owner will not be responsible for interpretations, conclusions, or quantity estimates drawn from this data by Contractor.

C. Subsurface Conditions: The subsurface conditions within the development areas are generally characterized in the geotechnical report prepared for the project site entitled Report, Geotechnical Investigation, Proposed Animal Shelter, Pomona, Rockland County, New York, prepared by Melick-Tully & Associates, dated September 14, 2021.

1. Boring logs are available for the Contractor’s review. The Owner makes no predictions or representations regarding the character or extent of soil, rock, or other subsurface conditions to be encountered during the work. The Contractor shall make his own deductions of the subsurface conditions which may affect the methods or cost of construction of the work hereunder, and he agrees that he will make no claims for damages or compensations, except as are provided under the agreement, should he find conditions during the progress of the work different from those as calculated or anticipated by him.
2. The Contractor, by careful examination, shall inform himself as to the nature and location of the work; the conformation of the ground, the nature of the subsurface conditions; the locations of the groundwater table; the character, quality and quantity of the materials to be encountered; the character of the equipment and facilities needed preliminary to and during the execution of the work; and all other matters which can in any way effect the work.
3. The Contractor shall be held to have visited the site and to have familiarized himself with the existing conditions of adjoining properties, utilities and buildings.
4. 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 or the conclusion drawn by the contractor based upon the additional exploratory operation.

D. 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 drip line 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.

F. Existing Utilities: Locate existing utilities 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 Civil 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.
   2. Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Construction Manager and then only after arranging to provide temporary utility services according to requirements indicated:
      a. Provide minimum of 48-hour notice to Construction Manager, and receive written notice to proceed before interrupting any utility.
      b. Do not proceed with utility interruptions without Civil Engineer's written permission.
      c. Demolish and completely remove from site all existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

G. Prevent undermining of pavements and slabs.

H. Extent of trench excavation and excavated areas will be controlled by site conditions and Civil Engineer’s requirements as indicated in the project plans and specifications.

I. Do not commence earth moving operations until temporary erosion and sedimentation control measures, specified in Section 312513 “Erosion Controls” are in place.

J. Provide groundwater and runoff controls consisting of drains and diversions or additional measures, as necessary, so as to maintain dry excavations. Implement in accordance with the SWPPP and regulations of the New York State Department of Environmental Conservation (NYSDEC).

K. Provide erosion and sediment controls and construction sequencing in accordance with the SWPPP and regulations of the New York State Department of Environmental Conservation.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Structural Fill: Structural Fill and Backfill (non-building related): Provide where indicated materials classified as GW, GP, SW or SP. The liquid limit of such material shall not exceed 35 percent when tested in accordance with ASTM D4318. The plasticity index shall not be greater than twelve percent (12%) when tested in accordance with ASTM D4318, and not more than fifteen percent (10%) by weight shall be finer than No. 200 sieve when tested in accordance with ASTM D1140. Material shall meet requirements for select structure fill according to NYSDOT Spec. Item 203.21.

B. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand, meeting the gradation of NYSDOT 2021 Standard Specifications Section 304 Type 4 material.

C. General Site Fill: Provide a soil material from the site that can be readily compacted to the specified densities. Materials shall be classified as GP, GM, GC, SP, SM or SC, and shall meet the requirements for select fill according to NYSDOT Spec. Section 203.06.

D. Pipe Bedding:
   1. Within County Highway Right-of-Way: #1 and #2 crushed stone bedding conforming to NYSDOT Material Specification 703.0201.
   2. Outside County Highway Right-of-Way: Mixture of crushed stone and gravel, free of soft, nondurable particles, organic materials and elongated particles. The maximum diameter of the large particles shall not exceed ¾ inches. When in ledge, use AASHTO No. 67 or approved equal processed sand and gravel, free of debris, clay lumps, organic, or other deleterious material. Compact in maximum 6 inch loose lifts.

E. Trench Backfill:
   1. Within County Highway Right-of-Way: NYSDOT Spec. Item 203.07 Select Granular Fill or equal.
   2. Outside County Highway Right-of-Way: Place above pipe backfill. Predominantly granular fill material. The maximum diameter of the large particles shall not exceed 3 inches. Compact in maximum 6 inch loose lifts to 95% modified Proctor Density.

F. Drainage Course, Choker Course and Reservoir Course for bioretention basins, asphalt porous pavement. All stone must be clean washed stone from the quarry or material producer, and meet the gradations referenced below:
   1. Drainage course: ASTM D-448, Size No. 57
   2. Checker course: ASTM D-448, Size No. 57
   3. Reservoir course: ASTM D-448, Size No. 3

2.2 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility.

B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep.

C. Identifying Colors for Utilities:
1. Red: Electric.
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.1 PREPARATION

A. Contact "Dig Safe New York" at 1-800-962-7962 before excavating. Proceed with excavation only after utility locator service completes marking of utility locations.

B. The Contractor shall furnish all labor, equipment and materials required to prepare site and to excavate all materials of whatever type encountered to the lines and grades shown on the Contract Drawings and as specified.

C. The Contractor shall give 72 hours advance notice to the Construction Manager and Owner's Special Inspector of the impending completion of excavations so as to allow inspection of the exposed surface for footings, slabs and pads and review the ground water conditions in accordance with the NYS Building Code requirements for Special Inspection.

D. The Contractor is to obtain and pay for all necessary permits to perform the work from the appropriate authorities and agencies prior to start of such work. Obey all applicable local and federal work safety rules and regulations.

E. Install all necessary protection equipment, structures such as fences, signs, scaffolding etc. prior to start of work.

F. Remove all existing structures, utilities, pavement in accordance with the Contract Documents.

G. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

H. Protect and maintain erosion and sedimentation controls during earth moving operations.

I. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary. Remove temporary protection and all frost damaged soils before placing subsequent materials.

J. Perform all excavations in accordance with current OSHA safety requirements. Excavation side slope support shall be provided using soldier piles and lagging, where necessary.

3.2 STORAGE OF SOIL MATERIALS

A. Storage of Soil Materials: Stockpile borrow materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Prevent windblown dust. Provide erosion and sediment control measures.

B. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

C. Stockpile on-site materials anticipated for re-use. Care shall be taken to avoid blending with the deleterious materials.

3.3 EXCAVATION

A. General
1. The excavation shall be unclassified and shall comprise and include the satisfactory removal and legal disposal of all materials encountered regardless of the nature of the materials and shall be understood to include miscellaneous fill, organics, granular soils, cobbles, boulders, foundation remnants, structures, slabs, walls, utilities, pavements, curbs, piping and debris.
2. All excavation shall be properly sized and shall extend to the depths of the form and size required for the installation of the work as indicated on the Contract Drawings. When excavations for foundation and site work have reached the required depths, the Special Inspector shall make an inspection of the conditions.
3. Excavation shall be to required elevations for footings, or other foundation elements. Excavation shall be made to a depth that will allow installation of full depth of concrete slabs, and any subbase materials as shown on Contract Drawings or specified. Excavation lines shall provide sufficient clearance for the proper execution of all concrete work including allowances for form work, shoring and inspection.

4. Materials that, in the opinion of the Owner's Engineer or Special Inspector, are not suitable for backfill, and any surplus earth, and all rock shall be removed from the site and legally disposed of.
5. The bottom of excavations shall be leveled off, free of standing water, snow, ice and loose materials, and graded to receive foundations, slabs, pits, trenches, grade beams, etc.
6. Where required, waterproofing shall be installed in accordance with the Contract Drawings and Specifications.
7. Subgrades shall be level and free of loose soil, standing water and frost prior to acceptance for placement of concrete or fill. Hand-excavate to achieve final subgrade elevation as directed by the Special Inspector or Owner's Engineer.
8. Contractor shall provide all equipment, labor and acceptable means necessary to maintain dry excavations at all times. No changes in the Contract Sum or the Contract Time will be authorized for dewatering, treatment, or disposal of water.

B. For Walks and Pavements:
1. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

C. For Utility Trenches:
1. Excavate trenches to indicated gradients, lines, depths, and elevations.
2. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit.
3. Clearance: min 12 inches each side of pipe or conduit.
4. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
5. Excavate trenches 12 inches deeper than elevation required in rock or other unyielding bearing material, 6 inches deeper elsewhere, to allow for bedding course.

D. Trenches in Tree- and Plant-Protection Zones:
1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrowtine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

E. Excavation for Footings.
1. Subgrades: Footing subgrades shall be approved by the Owner's Special Inspector before proceeding with the formwork, rebar or concrete placement. Bottoms of footings shall be founded on materials suitable for achieving the bearing pressures indicated on Contract Drawings and as approved by the Owner's Special Inspector.
2. Subgrade Bearing Capacity – The subgrade shall be as indicated on the Contract Drawings.

3. Subgrade of footings shall be level and free of loose rock, dirt, debris, standing water and frost before acceptance for placing concrete.
4. Unauthorized Excavation: When suitable bearing material is encountered at subgrade elevations shown and excavation is made to greater depth, the footings and foundation walls shall be extended to the lower elevation with concrete of the same strength used for the footing, at no additional cost to the Owner.
5. Authorized Additional Excavation: When unsuitable bearing material is encountered at subgrade elevations shown, the Owner's Special Inspector may require removal of unsuitable material and extension of footings and foundation walls.

F. Excavation for the Removal and Replacement Program.
1. Removal and Replacement Program: Unsuitable bearing materials at foundation bearing subgrades should be removed within the foundation zone of influence 1H:1V (i.e., 1 horizontal to 1 vertical) projection from the edge of the footing.
2. Subgrades: Subgrades shall be approved by the Owner's Special Inspector before proceeding with the fill placement and compaction of the over-excavation.
3. Unauthorized Excavation: When suitable bearing material is encountered at subgrade elevations shown and excavation is made to greater depth, the footings and foundation walls shall be extended to the lower elevation with concrete of the same strength used for the footing, at no additional cost to the Owner.
4. Authorized Additional Excavation: When unsuitable bearing material is encountered at subgrade elevations shown, the Owner's Special Inspector may require removal of unsuitable material and extension of footings and foundation walls.

G. Excavation for Slabs and Other Structural Members
1. Subgrades of slabs and other structural members, including framed slabs and grade beams, shall be approved by the Special Inspector before proceeding with their construction. Subgrades shall consist of material that meets the allowable bearing pressure requirements indicated in the Contract Documents. Subgrades resulting from excavation shall be free of unsuitable material (fill, loose materials, organics, debris, etc.) as judged by the Owner's Engineer or Special Inspector.
2. Unauthorized Excavation: Excavations performed below the elevations shown or specified, shall be filled and compacted as hereinafter specified, at no additional cost.
3. Authorized Additional Excavation: Where the Owner's Engineer or Special Inspector determines that the bearing material encountered is unsuitable, remove the unsuitable bearing material as directed. The removed material shall be replaced with structural fill or concrete as directed by the Owner's Engineer or Special Inspector

3.4 SUBGRADE

A. Proofrolling General
1. Proofrolling shall be performed for all soil subgrades within and outside the limits of the proposed development including all adjacent site work and pavements.
2. Proofrolling of soil subgrades shall conform to the following requirements:

a. All soil subgrades shall be compacted in the presence of the Owner's Special Inspector.
b. Proofrolling shall be accomplished with a minimum of six (6) overlapping cross-rolled coverages of a smooth drum vibratory roller having a static weight of at least 5 tons or as approved by the Owner's Engineer. A vibratory trench roller having a static weight of at least 1.5 tons shall be in confined areas as approved by the Owner's Engineer or Special Inspector. Areas inaccessible to the heavy equipment shall be compacted using a vibratory plate or jumping jack compactor as directed by the Owner's Engineer. The maximum travel speed of rollers should not exceed 1.5 mph.
c. Vibratory or impact compaction shall not be performed on soils which are not within 2 % of the optimum moisture content as determined by ASTM D1557.
d. Fill shall not be placed until the subgrade is approved by the Owner's Special Inspector.
e. Soft Areas during Compaction: Areas deemed unsatisfactory due to "pumping, rutting, or heaving" shall be undercut within the limits and extent ordered by the Owner's Special Inspector. These areas shall be replaced with an approved fill, and compacted to the requirements of this Section or as directed by the Owner's Special Inspector.

3. Do not proof-roll wet or saturated subgrades.
4. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Owner's Special, without additional compensation.

B. Approval:
1. Notify Owner's Special Inspector when excavations have reached required subgrade.
2. If Owner's Special Inspector determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
a. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

3.5 FILLING AND BACKFILLING

A. Filling and backfilling shall not be performed until related work has been inspected by the Special Inspector.

B. All subgrades shall be free of water, snow, ice, wood, organics, or other deleterious materials prior to placement of any fill.

C. Fill shall be placed such that there are no void spaces below floors, bottoms of pits, trenches, pipe haunches, pavements, etc.

D. Fill shall not be placed against concrete elements until the concrete has obtained its specified compressive strength, unless otherwise directed by the Owner's Engineer. Where fill is required on both sides of a wall, said fill shall be brought up simultaneously and evenly on both sides.

E. Fill voids caused by the removal of boulders, and/or below grade improvements, with lean concrete, or structural fill.

F. The Contractor shall supply and install all fill materials necessary to bring the ground surfaces to the required levels as shown on the Contract Drawings and as necessary to make the work complete.

G. All surplus materials shall be removed from the site and legally disposed of. Should additional material be required for the placing of backfill, other than material obtained from the site, the Contractor shall obtain, deliver, and place accepted backfill material as required.

H. Fill Placement:
   a. Begin placement of fill and backfill at the lowest section of the area. Spread material evenly by mechanical equipment or by manual means above the approved compacted subgrade in lifts not exceeding 12-inches for material compacted by heavy machinery and 4-inches for material compacted by light machinery or by hand tamping.
   b. Build layers as horizontally as practical to prevent thickness of lift from exceeding that specified but provide with sufficient longitudinal and transverse slope to provide for runoff of surface water from every point.

I. Moisture Control:
   a. The moisture-density curve for the fill used shall be supplied by the Contractor as a guide in controlling moisture to achieve the required degree of compaction. If, in the opinion of the Special Inspector, fill material becomes too wet for the required compaction, the fill shall be dried by a method approved by the Owner's Engineer prior to commencing or continuing compaction operations. Likewise, if, in the opinion of the Special Inspector, the fill material becomes too dry for the required compaction, the fill shall be moistened by a method approved by the Owner's Engineer prior to commencing or continuing compaction operations.

J. Compaction:
   a. Compact each lift to 95% of the maximum dry laboratory density as determined by ASTM D1557.
   b. The degree of compaction shall be checked by the Special Inspector and each successive lift shall not be placed or compacted until the previous lift is inspected and approved by the Special Inspector. Compact all fill to elevations and limits shown on Contract Drawings.

K. Frost:

a. Do not place fill materials when either the fill materials or the previous lift (or subgrade) on which it is placed is frozen. In the event that any fill which has already been placed on the surface shall become frozen, it shall be scarified and recompacted, or removed, to the approval of the Special Inspector before the next lift is placed. Remove or recompact any soft spots resulting from frost to the satisfaction of the Special Inspector before new fill is placed.

L. Filling and Backfilling Adjacent to Structures:
1. Place backfill adjacent to structures and compact to prevent wedging action or eccentric loading upon or against the structures.
2. Step or serrate slopes bounding or within areas to be backfilled to prevent sliding of the fill.
3. Do not use equipment for backfilling operations or for the formation of embankments against structures that will overload the structure.

3.6 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Place and compact initial backfill of subbase material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

D. Place and compact final backfill of satisfactory soil to final subgrade elevation.

E. Install detectable warning tape directly above utilities, 12 inches below finished grade.

3.7 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

B. Site Rough Grading: Slope grades to direct water away from structures and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
1. Turf or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1/2 inch.
3. Pavements: Plus or minus 1/2 inch.

C. Protect prepared areas from damage.

3.8 MAINTENANCE

A. Finished subgrades shall be verified to ensure proper elevation and conditions for construction above subgrade.

B. Protect subgrade from excessive wheel loading during construction, including concrete trucks and dump trucks.

C. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

D. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

E. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.

F. Where settling is measurable or observable at excavated areas during general project warrantee period, remove surface (pavement, or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.9 SOIL RESTORATION

A. The Contractor will be required to complete soil restoration in the areas of the proposed pervious surfaces once final grade has been achieved in these areas. The type of soil restoration will depend on the type of soil disturbance and the type of hydrologic soil group. The Contractor will be required to complete soil restoration in conformance with the various methods outlined in the following table:

Type of Soil Disturbance	Soil Restoration Requirement
Minimal Soil Disturbance (e.g., clearing and grubbing)	Restoration not required
Areas where topsoil is stripped only (e.g., no change in grade)	Apply 6 inches of topsoil
Areas of cut or fill	Aerate and apply 6 inches of topsoil
Heavy traffic areas on-site (especially in 5 feet to 25 feet around buildings, but not within a 5 foot perimeter around foundation walls)	Apply full soil restoration

Type of Soil Disturbance	Soil Restoration Requirement
Areas where runoff reduction or infiltration practices are applied	Restoration may not be required, but may be applied to enhance the reduction specified for the appropriate practices.

B. Before applying full soil restoration, all construction activity, including construction equipment and material storage, site cleanup and trafficking, should be finished and the site closed to further disturbance. Full soil restoration is implemented in a two-phase process:
   1. Deep rip the affected thickness of exposed subsoil material, aggressively fracturing it before the protected topsoil is reapplied on the site.
   2. Decompact, simultaneously through the restored topsoil layer and upper half of the affected subsoil.

C. During periods of relatively low to moderate subsoil moisture, the disturbed soils are returned to rough grade and the following is applied:
   1. Apply 3 inches of compost over the subsoil.
   2. Till compost a minimum of 12 inches into the subsoil using a cat-mounted ripper, tractor-mounted disc, or tiller mixing and circulating air and compost into subsoils.
   3. Rock-pick until uplifted stone/rock materials of 4 inches or larger size are cleaned off the site. All construction/foreign debris and existing root masses shall be removed from proposed planting areas.
   4. Apply 6 inches of topsoil. Newly installed planting soils shall be mixed with existing soils where they meet in order to create a transitional gradient to allow for proper drainage.
   5. Install plants and vegetation in accordance with the Landscaping Plan.

3.10 SUBBASE AND BASE COURSES

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course under pavements and walks as follows:
   1. Shape subbase course to required crown elevations and cross-slope grades.
   2. Place subbase 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 subbase course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 98 percent of maximum dry unit weight according to ASTM D 1557.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform tests and inspections.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; re-compact and retest until specified compaction is obtained.

D. The Owner will employ, at his own expense, an Engineer to review all laboratory test results and submitted reports specified in this Section.

E. The Owner's Engineer will interpret the tests, state in each report whether or not the test specimens and results comply with all requirements of the Contract Documents, and note any deviations.

F. The Owner's Engineer will identify when and where samples are to be obtained for the use of on-site materials. The Contractor shall collect samples, provide all necessary laboratory testing, and shall submit the following laboratory test reports to the Owner's Engineer for review:
1. Gradation Analysis - ASTM D422.
2. Atterberg limits - ASTM D4318.
3. Modified Moisture-density curve determination - ASTM D1557.

G. The Owner's Engineer will determine the conformance of materials to be used for fills.

H. Backfilling and Compaction: Backfilling and compaction below foundations, slabs, behind foundation walls, and any other backfilling and compaction work shall be inspected by the Special Inspector. No fill shall be placed unless the previous lift is approved by the Special Inspector. The Special Inspector shall take field density tests of the subgrade for every 1,000 square feet, but not less than 3 tests in each compacted fill layer. Field density tests shall be performed in accordance with ASTM D2922.

I. The Contractor shall cooperate with the Special Inspector in the performance of the required tests and inspections.

3.12 PROTECTION AND REPAIR

A. Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris. Protect subgrade from excessive wheel loading during construction, including concrete trucks and dump trucks.

B. Repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

D. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

E. Finished subgrades shall be verified to ensure proper elevation and conditions for construction above subgrade.

F. Where settling is measurable or observable at excavated areas during general project warrantee period, remove surface (pavement, or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.13 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

3.14 CLOSEOUT

A. Substantial Completion Requirements:
   1. Provide final cleaning immediately prior to Substantial Completion inspection.

B. Corrective Work:
   1. Remove, repair and reinstall, or restore in place damaged items.
   2. Replace damaged materials or items with new if repair not acceptable to Architect.

C. Provide product data to complete Operation & Maintenance Manuals.

D. Submit executed Warranties.

END OF SECTION 31 00 00

SECTION 31 10 00 – SITE CLEARING

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. This Section includes the following:
1. Protecting existing vegetation to remain.
2. Removing existing vegetation and trees.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, removing site utilities and abandoning site utilities in place.

B. Related Sections include the following:
1. Section 31 00 00 – Earthwork.
2. Section 31 25 13 – Erosion and Sediment Control.

1.3 REFERENCES

A. "Report, Geotechnical Investigation, Proposed Animal Shelter, Pomona, Rockland County, New York" prepared by Melick-Tully & Associates, dated September 14, 2021.

1.4 DEFINITIONS

A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil, and is the zone where plant roots grow.

D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and as indicated on Drawings.

E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.5 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

B. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.

C. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

D. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

E. Do not commence site clearing operations until temporary erosion and sedimentation control, wetland vegetation, and plant and tree protection measures are in place.

F. The following practices are prohibited within protection zones:
1. Land or vegetation disturbance.
2. Storage of construction materials, debris, or excavated material.
3. Parking vehicles or equipment.
4. Foot traffic.
5. Erection of sheds or structures.
6. Impoundment of water.
7. Excavation or other digging unless otherwise indicated.
8. Attachment of signs to, or wrapping materials around trees or plants unless otherwise indicated.

G. Do not direct vehicle or equipment exhaust towards protection zones.

H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

I. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

J. Tree clearing shallow occur within the required tree clearing period to protect endangered bat species or as specified by authorities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Construction Fencing

1. Where indicated on the Drawings or as required to provide visual warning and control, provide plastic mesh fencing supported by steel posts driven into ground or set in precast concrete blocks.
2. Height: 36 inches minimum.
3. Color: Safety orange.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly identify trees, shrubs, and other vegetation to remain. Install tree protection and construction fencing in accordance with plans.

C. Protect existing site improvements to remain from damage during construction.
1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TREE AND PLANT PROTECTION

A. General: Protect trees and plants remaining on-site according to requirements in this section.

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Owner's representative.

3.3 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

B. Arrange with utility companies to shut off indicated utilities.

C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted by the utility company and then only after arranging to provide temporary utility services according to their requirements.

D. Excavate for and remove underground utilities indicated to be removed.

3.4 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.

2. Grub stumps and remove roots, obstructions, and debris to a depth of 18 inches below exposed subgrade.
3. Use only hand methods for grubbing within protection zones.
4. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

C. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.5 TOPSOIL-STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil in a manner to prevent intermingling with underlying subsoil or other waste materials.
1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover and stabilize to prevent windblown dust and erosion by water.
1. Do not stockpile topsoil within protection zones.
2. Stockpile surplus topsoil to allow for re-spreading deeper topsoil.

3.6 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove concrete slabs, paving, curbs, gutters, and aggregate base as indicated.
1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.7 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property. These materials are the contractor’s property.

B. Separate recyclable materials produced during site clearing from other non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 31 10 00

SECTION 31 25 13 - EROSION AND SEDIMENT CONTROL

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. This Section includes the following:
1. Silt Fence.
2. Inlet Protection.
3. Stabilized Construction Entrance.
4. Temporary Seeding and Mulching
5. Dust Control.
6. Concrete Washout.

B. Related Sections includes the following:
1. Section 31 00 00 – Earthwork.

1.3 REFERENCES

A. Erosion and Sediment Control Guidelines: Conform to the latest edition of "New York State Standards and Specifications for Erosion and Sediment Control".

B. Storm Water Management: Conform to the latest edition of "New York State Stormwater Management Design Manual".

1.4 SUBMITTAL

A. Product Data: Submit data on:
1. Silt fence.
2. Each type of geotextile and/or filter fabric.
3. Inlet protection.
4. Temporary seeding and mulching.

PART 2 - PRODUCTS

2.1 SILT FENCE/GEOTEXTILE

A. Filter Fabric: Woven geotextile, 36 inches max. height shall have minimum acceptable values as follows:
1. Grab Tensile Strength – 90 lbs per ASTM D1682
a. Elongation at failure – 50% per ASTM D1682

b. Mullen Burst – 190 psi per ASTM D3786
c. Puncture Strength – 40 lbs per ASTM D751
d. Slurry Flow Rate – 0.3 gal/min/sf
e. Equivalent Opening Size – 40-80 US Std Sieve CW-02215
f. Ultraviolet Radiation Stability – 90% per ASTM G-26

B. Fence posts: 36 inches long quality hardwood with minimum cross-sectional area of 3 square inches.

C. Woven wire: 14-1/2 gauge, 6 inch maximum mesh opening.

D. Product and manufacturer:
1. Envirofence.
2. Geofab.
3. Or approved equal.

2.2 INLET PROTECTION

A. Silt Sack Inlet Protection
1. Product Manufacturer
a. ACF Environmental Products.
b. Dandy Bag by Dandy Products.
c. Or approved equal.

2.3 STABILIZED CONSTRUCTION ENTRANCE

A. Stone: 1-inch to 4-inch stone, or reclaimed or recycled concrete equivalent, as indicated on the Drawings.

B. Synthetic Filter Fabric: Woven or non-woven geotextile, conforming to the following:

Properties	Light Duty Rd Requirement	Heavy Duty Rd Requirement	Unit
Grab Tensile Strength (ASTM D1682):	200	220	Lbs
Grab Tensile Elongation (ASTM D1682):	50	60	Percent
Mullen Burst Strength (ASTM D3786):	190	430	psi
Puncture Strength (ASTM D751 modified):	40	125	Lbs
Equivalent Opening Size (CW-02215):	40-80	40-80	US Std Sieve
Aggregate Depth:	6	10	Inches

2.4 TEMPORARY SEEDING

A. Seed Mixtures
   1. Spring, Summer, or Early Fall: seed area with ryegrass (annual or perennial) at a rate of 30 lbs. per acre (1 lb. per 1,000 square feet).
   2. Late Fall or Early Winter: seed area with certified 'Aroostook" winter rye (cereal rye) at a rate of 100 lbs. per acre (2.5 lbs. per 1,000 square feet).

B. Fertilizer or lime is not required for temporary seeding.

2.5 TEMPORARY STRAW MULCH

A. All straw mulch material shall be in an air dried condition free of noxious weeds and other materials detrimental to plant life. Straw shall be seasoned before bailing or loading. Straw mulch so provided shall be suitable for spreading with mulch blower equipment.

2.6 DUST CONTROL

A. Water: Potable.

2.7 CONCRETE WASHOUT

A. As shown on the project plans.

PART 3 - EXECUTION

3.1 GENERAL

A. Minimize environmental damage during construction. Prevent discharge of fuel, oil, lubricants, and other fluids. Mitigate effects of discharge.

B. Install erosion and sediment control measures prior to clearing, demolition or construction.

C. Construct erosion and sediment control measures in accordance with standards and specifications of the "New York Standards and Specifications for Erosion and Sediment Control".

D. Install additional control measures, if deemed necessary by the State, County, or Engineer.

E. Implement and maintain the Erosion and Sediment Control Plan. Inform parties engaged on the construction site of the requirements and objectives of the plan. Notify the proper County agency of transfer of this responsibility.

F. Protect catch basins with inlet protection throughout construction until disturbed areas are stabilized.
   1. Remove and dispose of sediment from control structures after stabilization.

G. Control dust and wind erosion. Control dust to prevent a hazard to traffic on adjacent roadways. Dust control includes sprinkling of water and uniform application of calcium chloride on exposed soils and haul roads.

H. Do not discharge directly into wetlands or watercourses where dewatering is necessary. Utilize methods and devices as permitted by authorities having jurisdiction and appropriate regulations to minimize and retain suspended solids including pumping water into a temporary sedimentation bowl, providing surge protection at inlet and outlet of pumps, floating pump intake.
1. If pumping operation results in turbidity problems, stop pumping until means of controlling turbidity are determined and implemented.

I. Within 7-days of completing slope construction, stabilize slopes with vegetation or matting to minimize exposure.

J. Stockpiles
1. Side Slopes: 2:1 maximum.
2. Surround stockpiles with silt fence.
3. Stabilize stockpiles left bare for more than 14-days with temporary vegetation or mulch.

K. Final Grading
1. If final grading is delayed for more than 14- days after land disturbances cease, stabilize soils with temporary vegetation or mulch.

L. Planting Season for Temporary Vegetation
1. March 1 to October 1.
2. After September 15, stabilize areas with silt fence, hay, or woodchip mulch.

M. Areas to Be Left Bare Prior to Finished Grading and Seeding
1. Within Planting Seasons
   a. Temporarily seed with Perennial Ryegrass
   b. Apply at a rate of 2-pounds per 1,000-sqaure-foot at a depth of ½-inch.
   c. Where grass predominates, fertilize according to a soil test at a minimum application rate of one pound per acre.
2. Outside of Planting Seasons
   a. Apply air-dried wood chip mulch, free of coarse matter.
   b. Apply at a rate of 185-pounds- to 275-pounds-per-1,000-square-feet.

3.2 MAINTENANCE

A. Control Systems
1. Maintain in good condition throughout construction period.
2. Inspect control system daily and immediately after each rainfall. Make repairs immediately.
3. Remove and dispose of accumulated sediments when sediment reaches approximately one-third the height of the control system, or when directed by the Engineer.
4. Replace control system promptly if fabric decomposes or system becomes ineffective prior to the expected usable life.

5. Maintain or replace system until no longer necessary for the intended purpose.
6. Sweep adjacent roadways daily to remove tracked material from pavement.

3.3 REMOVAL

A. Remove and dispose of control system after area stabilizes with new growth or as directed by the Engineer.

END OF SECTION 31 25 13

SECTION 32 12 16 - ASPHALT PAVING

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. This Section includes the following:
   1. Hot-mix asphalt patching.
   2. Hot-mix asphalt paving.
   3. Hot-mix asphalt paving overlay.

B. Related Sections includes the following:
   1. Section 31 00 00 – Earthwork.
   2. Section 32 17 23 – Signs and Pavement Markings.

1.3 REFERENCE STANDARDS

A. New York State Department of Transportation (DOT) Specification section 400 dated September 1, 2021.

1.4 SUBMITTAL

A. Product Data Product Data:
   1. Asphaltic Pavement: Include mix design from NYSDOT approved Batch Plant, Mix Design Test results that are less than 6 months old.

B. Batch plant name, NYSDOT Plant Number, and location of asphalt plant.

C. Pavement Quality Control Submittals: Material Delivery Tickets
   1. At the time of delivery, a copy of the delivery ticket must be presented to the Owner's Representative with the following minimum information:
      a. Ticket Number.
      b. Plant Identification.
      c. Project Name.
      d. Mix Type.
      e. Quantity of material in vehicle.
      f. Date and Time.

1.5 PROJECT CONDITIONS

A. Environmental Requirements:

1. Discontinue paving when surface temperatures fall below requirements listed in DOT Table 402-1 unless otherwise specified in the General Conditions of this Contract or as directed by the Owner's Representative.
2. Do not place asphalt concrete on wet surfaces, or when weather conditions otherwise prevent the proper handling or finishing of bituminous mixtures as determined by the Owner's Representative.
3. Pavement is restricted by dates listed in the General Conditions or by temperatures.

PART 2 - PRODUCTS

2.1 ASPHALTIC CONCRETE

A. All aggregate used in design mixes shall be as specified in DOT Specification Section 401-2.02 B.; Coarse Aggregate Type F2 Conditions.

B. Hot Mix Asphalt (HMA): Use aggregate and PG binder from suppliers listed in the NYS DOT's Approved List for Fine and Coarse Aggregates and Performance Graded (PG) Binders for Hot Mix Asphalt (HMA) Paving respectively. Use of mineral filler or any other materials for the production of HMA will be accepted in accordance with the State's written instructions.

C. Supply approved HMA mixtures that meet the requirements of NYS DOT MM 5.16 Superpave Hot Mix Asphalt Mixture Design and Mixture Verification Procedures. Each mixture must be obtained from a single plant for the duration of the project. The following NYS DOT items only shall be utilized for this project:
   1. 12.5 Top Course HMA.
   2. 25.0 Binder Course HMA.
   3. 37.5 Base Course HMA.

D. Reclaimed Asphalt Pavement (RAP) will not be accepted.

E. Asphalt Cement Tack Coat.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that all grades onto which asphaltic concrete is to be placed are at the required levels prior to placement. Verify that all miscellaneous concrete work has been installed. Notify the Civil Engineer in writing of conditions that will interfere with the proper completion of this Work. Do not begin work until all improper conditions are remedied. Installation of aggregate base is described in Section 31 00 00 "Earthwork".

3.2 PRE-CONSTRUCTION MEETING

A. The Owner's Representative will conduct a Pre-Paving meeting prior to any Hot Mix Asphalt (HMA) placement. The attendance at this meeting will include Contractor's Paving

Superintendent, Chief Inspector or Paving Inspector(s), HMA plant representative, density gauge operator, depending on the compaction method used, and work zone traffic control (WZTC) competent person (if applicable). The contractor's Paving Superintendent must be prepared to discuss the operation necessary to complete the work successfully. Participants will review all aspects of the project requirements including, but not limited to, the following:

1. HMA delivery temperature.
2. Equipment and setup.
3. Mix codes to ensure the correct mix is delivered.
4. Frequency of testing.
5. Density Gauge operator certification.
6. Proper construction practice to provide quality product.
7. Work zone traffic control activities necessary.

3.3 ASPHALT PAVING PLACEMENT & COMPACTION

A. Prepare existing surfaces in accordance with DOT Section 402-3.05, *Conditioning of Existing Surface*.

B. Apply Tack Coat in accordance with DOT Section 407-3.02, *Application of Tack Coat*, specifically Table 407-1 – Tack Coat Application Rates. The rates listed are recommended application rates for tack coat on various surfaces and may be modified by the Owner's Representative.

C. Spread and Finish HMA in accordance with DOT Section 402-3.05, *Spreading and Finishing*.

D. Provide compaction of HMA in accordance with DOT Section 402-3.07, *Compaction*.
   1. Paragraph D. 80 Series Compaction Methods, specifically meeting the minimum requirements as shown in Table 402-6 Number of Passes. The Owner's Representative may increase or decrease the number of passes to obtain adequate density of the compacted HMA.
   2. The Owner's Representative may also approve alternate compaction procedures where the specified procedures are not applicable.
   3. Testing to be performed at the direction of and in locations chosen by the Owner's Representative. Target compaction is 95% (92% - 97% range is acceptable).

E. HMA joints shall be in accordance with DOT Section 402-3.09, *Joints*.

F. Construct each pavement course to a ¼" surface tolerance. The Owner's Representative may test the surface with a 16-foot straight edge or string line placed parallel to the centerline of the pavement and with a 10-foot straight edge or string line placed transversely to the centerline of the pavement on any portion of the pavement. Variations exceeding ¼ inch will be appropriately corrected or the pavement be removed and replaced at no additional cost to the Owner.

G. The allowable thickness tolerance of all HMA mixtures shall be:
   1. 1/4 inch or less when the total nominal thickness indicated on the plans is 4 inches or less.

2. 1/2 inch or less when the total nominal thickness is over 4 inches but not more than 8 inches.
3. When the HMA mixture is placed on newly constructed subbase material, an additional tolerance of 1/4 inch will be allowed both in the nominal thickness of the course placed directly on the subbase and the total pavement thickness.

H. Remove and restore paved areas that are defective or contaminated as delineated by the Owner's Representative at no additional cost to the Owner.

I. Do not clean tools and equipment used for HMA placement on the pavement surface, or near streams, ponds, drainage structures or other areas that are tributaries to waterways. Use an area approved by the Owner's Representative for cleaning all paving equipment and tools.

J. Once pavement cures for a minimum of 24 hours, apply pavement markings with mechanical equipment to a minimum wet film thickness of 15 mils (0.4 mm), or as specified by the Manufacturer if greater.

END OF SECTION 32 12 16

SECTION 32 13 00 – CONCRETE WALKS AND CURBS

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. This Section specifies cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes, for the following:
   1. Sidewalks.
   2. Driveway aprons.
   3. Sidewalk ramps.
   4. Concrete curbs.
   5. Concrete pads.

B. Related Sections includes the following:
   1. Section 31 00 00 – Earthwork.

1.3 DEFINITIONS

A. Cementitious Material: Cementitious materials include cement, ground blast furnace slag and fly ash.

B. Corrosion Inhibitor Admixture: A liquid admixture, calcium nitrite that inhibits corrosion of concrete-embedded steel in the presence of chloride ions.

C. Pumped Concrete: Concrete that is conveyed by pumping pressure through rigid pipe or flexible hose.

D. Water-to-Cementitious Ratio (w/c): A ratio representing quantity in pounds of free moisture available for cement hydration divided by quantity of cementitious materials in pounds per cubic yard concrete.

1.4 SUBMITTALS

A. Product Data:
   1. Submit product data for design mix(es) and materials for concrete specified for each type of manufactured material and product indicated.
   2. ADA Detectable Warning Surface: Manufacturer's specifications, product data, test reports, method of installation, and maintenance instructions.

B. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:

1. Cementitious materials and aggregates.
2. Admixtures.
3. Curing compounds.
4. Bonding agent or adhesives.
5. Joint fillers.

1.5 QUALITY ASSURANCE

A. Concrete batching plants shall be currently approved as concrete suppliers by the New York State Department of Transportation.

B. Installer Qualifications: An experienced installer who has completed pavement work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Manufacturer Qualifications:
   1. Concrete
      a. Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
      b. Manufacturer must be certified according to the National Ready Mix Concrete Association's Plant Certification Program.
   2. Reinforcement
      a. Affidavit by the bar reinforcement manufacturer certifying that bar material meets the contract requirements.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant and each aggregate from one source.

E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixes.

1.6 DELIVERY

A. Batch Tickets shall have all of the information required by ASTM C94-C94 M and the following:
   1. Type and brand, and amount of cement.
   2. Weights of fine and coarse aggregates.
   3. Class and brand, and amount of fly ash (if any).

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 CONCRETE SIDEWALK AND DRIVEWAY RAMP

A. Concrete sidewalk shall be of one course, consisting of a single course of concrete 4-inches thick.

B. The sidewalk shall be of the width specified and shall be laid on a clean crushed stone or gravel foundation 18” thick.

2.2 PEDESTRIAN SIDEWALK RAMP

A. The maximum slope of a pedestrian sidewalk ramp in new construction shall be 1:12.

B. If a curb ramp is located where pedestrians must walk across the ramp, then it shall have flared sides; the maximum slope of the flare shall be 1:12. Curb ramps with returned curbs may be used where pedestrians would not normally walk across the ramp.

C. The transition where curb meets ramp at the pavement shall be flush.

D. The ramps are to consist of concrete with a compressive strength of 4,000 psi at 28 days, 4" thick with welded wire (W1.4xW1.4 6" x 6") fabric on 18" of compacted crushed stone base material.

E. All newly constructed pedestrian sidewalk ramps shall be fitted with detectable warning dome modular pavers as manufactured by Armor-Tile Tactile Systems or approved equal. The modular pavers shall be dark gray in color for residential areas and yellow in color for commercial/industrial areas.

2.3 CONCRETE CURB

A. Concrete for curb shall comply with the requirements as specified herein. At minimum the concrete shall test 4,000 psi at 28 days.

B. Excavation shall be made to dimensions sufficient to permit the setting of forms.

C. The material underlying concrete curb shall be satisfactory and thoroughly compacted. Any unsuitable material shall be removed and replaced with acceptable material.

D. Curbs shall be moulded in place with provisions made for expansion by use of one-half (1/2) inch approved pre-moulded joint filler at minimum twenty (20) foot intervals.

E. Forms shall be either of metal of sufficient thickness, but not less than 1/8 inch, to resist distortion satisfactorily when fastened together and secured in place, or be of acceptable planed or matched lumber of sufficient thickness to resist distortion, rigidly held in position and of such construction that a smooth surface will be provided.

F. Forms shall have suitable metal dividing plates approximately 3/16 inch thick, be of a depth (including dividing plates approximately 3/16 inch thick, be of a depth (including dividing plates) not less than that of the curb, be properly located with tops at grade and be left in place until the concrete has hardened. Upon removal of the curb form, the curb shall be immediately rubbed down to a smooth and uniform surface but no plastering will be allowed. Concrete curb shall be carefully protected against injury from rain, frost, the drying effects of the sun and wind, traffic or other hazards and cured by the use of "Colorless Curecrete" or an equivalent approved product applied in accordance with Manufacturer's Standard Practice. Any curb

which is damaged at any time previous to the final acceptance of the work shall be removed and replaced with satisfactory curb at the Contractor's expense.

G. Concrete shall not be placed for concrete curbs unless the surface temperature is 40°F or rising.

2.4 CONCRETE PADS

A. Concrete pads shall be of one course, consisting of a single course of concrete 8-inches thick.

B. The pads are to consist of concrete with a compressive strength of 4,000 psi at 28 days with #4 reinforcement bars at 12" on center in each direction.

C. The pads shall be of the dimensions specified and shall be laid on a clean crushed stone foundation 18" thick.

2.5 CONCRETE MATERIALS

A. Mix Type: ASTM #57/#67, Conventional, Straight Cement – 4,500 psi

1. Mix Materials

Material	Type	Specific gravity	Standard
Cement	Type I/II	3.15	ASTM C150
Fine Aggregate	Natural Sand	2.63	ASTM C33
Coarse Aggregate	#67 Stone	2.83	ASTM C33
Air Entrainment Admixture	---	---	ASTM C260
Water Reducing Admixture	---	---	ASTM C494

2. Sieve Analysis

Sieve size	Fine Aggregate (% passing by weight)	Coarse Aggregate (% passing by weight)	
	ASTM C33 Fine Agg	ASTM C33 #67 Stone	ASTM C33 #57 Stone
25.0 mm	---	100	95 – 100
19.0 mm	---	90 – 100	---
12.5 mm	---	---	25 – 60
9.5 mm	100	20 – 55	---
#4	95 - 100	0 – 10	0 – 10
#8	80 - 100	0 – 5	0 – 5
#16	50 - 85	---	---
#30	25 – 60	---	---
#50	5 – 30	---	---
#100	0 - 10	---	---

2.6 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
   1. Use flexible or curved forms for curves of a radius 100 feet or less.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.7 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

B. Reinforcement Bars: ASTM A 615/A 615M, Grade 60, deformed.

C. Plastic-surfaced or reinforced-paper-covered dowels are available from proprietary sources.

D. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.

E. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.

F. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement bars, welded wire fabric, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:
   1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2.8 ADMIXTURES

A. General: Admixtures certified by manufacturer to contain no more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures.

B. Air-entraining Admixture: ASTM C 260.

C. Water-reducing Admixture: ASTM C 494/C 494M, Type A.

2.9 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

E. White Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B.

2.10 JOINTS

A. Construction joints and other bonded joints:
1. Use an acceptable adhesive applied in accordance with the manufacturer's recommendations;
2. Use an acceptable surface retarder in accordance with manufacturer's recommendations;
3. Roughen the surface in an acceptable manner that exposes the aggregate uniformly and does not leave laitance, loosened particles of aggregate, or damaged concrete at the surface; or
4. Use Portland-cement grout of the same proportions as the mortar in the concrete in an acceptable manner.

B. Isolation-joint filler materials:
1. Except as otherwise shown on the Drawings, expansion joints shall be as follows:
   a. In joints required to receive a sealant, the joint filler shall be 1/2 inch thick and recessed as required to form a caulking slot.
   b. In joints not required to receive a sealant, the joint filler shall be 1/2 inch thick and extend through the full cross-section of the concrete.
   c. Tool edges of concrete with 1/8 inch radius edging tool.

2.11 PRODUCTION OF CONCRETE

A. Provide ready-mixed concrete, either central-mixed or truck-mixed, unless otherwise approved in writing by the Director.

B. Weather considerations
1. Provide adequate controls to insure that the temperature of the concrete when placed does not exceed 90 degrees F., and make every effort to place it at a lower temperature. The temperature of the concrete as placed shall not be so high as to cause difficulty from loss of slump, flash set or cold joints. Ingredients may be cooled before mixing by shading the aggregates, fog spraying the coarse aggregate, chilling the mixing water or other approved means. Mixing water may be chilled with flake ice or well-crushed ice of a size that will melt completely during mixing, providing the water equivalent of the ice is calculated into the total amount of mixing water.

C. Protect concrete from physical damage or reduced strength due to weather extremes during mixing, placement and curing.
1. In cold weather, comply with ACI 306R.
   a. When air temperature is below 40 degrees F (4 degrees C) heat the mixing water and, if necessary, the aggregates to obtain a concrete mixture temperature of not less than 50 degrees F (10 degrees C) and not more than 80 degrees F (27 degrees C) at point of placement. If the mixing water is heated, do not exceed a temperature of 140 degrees F at the time it is added to the cement and aggregates.

2. In hot weather, comply with ACI 305R.
   a. When air temperature is between 85 degrees F (30 degrees C) and 90 degrees F (32 degrees C), reduce mixing and delivery time from 1 1/2 hours to 75 minutes, and when air temperature is above 90 degrees F (32 degrees C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 PREPARATION

A. The earth subgrade, immediately before foundation material is placed on it, shall be compacted, smooth, parallel to and at the required depth below the finished sidewalk surfaces and be dampened with water sufficient only to be absorbed by the subgrade. The subgrade shall not be in a muddy or frozen condition and unsuitable materials shall be removed and replaced with acceptable material thoroughly compacted.

B. The foundation shall consist of crushed stone base or gravel material, compacted to a uniform thickness of eighteen (18) inches, top surface shall be uniformly 4" below the finished grade of the sidewalk or 8” below the finished grade of the concrete pad.

C. The forms shall be set accurately to line and grade as directed by the Engineer, and held rigidly in place in an approved manner. These forms shall consist of a satisfactory lumber two (2) inches thick, or steel of equal strength and shall be left in place until the concrete is satisfactorily set. After the concrete has set a minimum of three (3) days, the forms shall be removed and the area left shall be restored to the existing grade as directed by the Engineer.

D. Concrete sidewalk shall be reinforced with sheets of steel fabric in accordance with the Specifications.

E. Steel fabric reinforcement for sidewalk shall consist of W1.4 (0.133 inch) wire at six (6) inch centers transversely and longitudinally. All point of intersection of the members shall be firmly welded in an approved manner. All fabric joints shall be lapped at least six (6) inches. All steel fabric shall be delivered in flat sheets or roles of such width as to fit the concrete driveway and corners and shall have the manufacturer and size of steel identified by attached tag. All outside members shall be not more than three (3) inches from edges of driveway.

F. The walk shall be divided into sections of the required dimensions, as directed by the Engineer.

G. The surface edges of each section shall be marked in the Top Course directly over these joints, with a trowel or other suitable tool, and be rounded to a 1/4" radius.

H. The concrete shall be proportioned as specified, thoroughly mixed and then placed immediately in the forms. It shall then be thoroughly compacted by tamping and struck off with a template and shall be floated with a wood float until the surface has a true contour. Care shall be taken not to bring to the surface an excess of water and sand by over-finishing.

I. Concrete shall be carefully protected against injury from rain, frost, the drying effects of the sun and wind, traffic or other hazards. Walks and pads shall be treated with "Aqua-Cure VOX" or

an equivalent product applied according to the Manufacturer's Standard Practice. Any other method of protection and curing will be subject to the approval of the Engineer.

J. Concrete shall not be placed for concrete sidewalks, curbs, pads, and/or driveway aprons unless the surface temperature is 40°F or rising.

3.2 EDGE FORMS AND SCREENED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form release agent to ensure separation from concrete without damage.

3.3 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating reinforcement and with recommendations in CRSI's "Placing Reinforcing Bars" for placing and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.4 JOINTS

A. A. General: Construct construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
   1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour, unless pavement terminates at isolation joints.
   1. Provide preformed galvanized steel or plastic keyway-section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
   2. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
   3. Provide tie bars at sides of pavement strips where indicated.
   4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
1. Locate expansion joints at intervals of 12 feet, unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with groover tool to the following radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
a. Radius: 1/4 inch.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to the following radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.
1. Radius: 1/4 inch.

3.5 CONCRETE PLACEMENT

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcement steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.

D. Comply with requirements and with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery, at Project site, or during placement.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete by mechanical vibrating equipment supplemented by handspading, rodding, or tamping. Use equipment and procedures to consolidate concrete according to recommendations in ACI 309R.
   1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for handspading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

H. Screed pavement surfaces with a straightedge and strike off. Commence initial floating using bull floats or darbies to form an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading dry-shake surface treatments.

I. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.

J. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
   1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
   2. Do not use frozen materials or materials containing ice or snow.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

K. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows when hot-weather conditions exist:
   1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
   2. Cover reinforcement steel with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
   3. Fog-spray forms, reinforcement steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.6 CONCRETE FINISHING

A. General: Wetting of concrete surfaces during screeding, initial floating, or finishing operations is prohibited.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surface with power-

driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots, and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
2. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiffbristled broom, perpendicular to line of traffic.

3.7 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:
   1. Elevation: 1/4 inch.
   2. Thickness: Plus 3/8 inch, minus 1/4 inch.
   3. Surface: Gap below 10-foot long, unleveled straightedge not to exceed 1/4 inch.
   4. Joint Spacing: 3 inches.
   5. Contraction Joint Depth: Plus 1/4 inch, no minus.
   6. Joint Width: Plus 1/8 inch, no minus.

3.8 REPAIRS AND PROTECTION

A. Remove and replace concrete that is broken, damaged, or defective, or does not meet requirements in this Section.

B. Drill test cores where directed by Civil Engineer when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with Portland cement concrete bonded to pavement with epoxy adhesive.

C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 13 00

SECTION 321413

PRECAST CONCRETE UNIT PAVING

PART 1 GENERAL

1.01 REFERENCES

A. American Society of Testing and Materials (ASTM) (latest edition):
1. C 29, Bulk Density and Voids in Aggregate Materials.
2. C 33, Specification for Concrete Aggregates.
3. C 136, Method for Sieve Analysis for Fine and Coarse Aggregate.
4. C 140, Sampling and Testing Concrete Masonry Units.
5. D 448, Classification for Sizes of Aggregate for Road and Bridge Construction.
6. C 936, Specification for Solid Interlocking Concrete Paving Units.
7. C 979, Specification for Pigments for Integrally Colored Concrete.
8. D 698, Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 5.5 lb (24.4 N) Rammer and 12 in. (305 mm) drop.
9. D 1557, Test Methods for Moisture Density Relations of Soil and Soil Aggregate Mixtures Using a 10-lb (44.5 N) Rammer and 18 in. (457 mm) drop.
10. C1645, Standard Test Method for Freeze-thaw and De-icing Salt Durability of Solid Concrete Interlocking Paving Units
11. D 4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
12. D 4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
13. D 4533, Standard Test Method for Index Trapezoidal Tearing Strength of Geotextiles
14. D 4833, Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes and Related Products
15. D 4491, Standard Test Method for Water Permeability of Geotextiles by Permittivity
16. D 4751, Standard Test Method for Determining Apparent Opening Size of a Geotextile

1.02 QUALITY ASSURANCE

A. Installation shall be by a contractor and crew with at least one year of experience in placing interlocking concrete pavers on projects of similar nature.

1.03 SUBMITTALS

A. Shop or product drawings and product data.

B. Full size samples of concrete paving units shall be submitted to indicate color and shape selections.

C. Sieve analyses for grading of bedding and joint aggregate.

D. Test results shall be submitted from an independent testing laboratory for compliance of paving unit requirements to ASTM C 936 or other applicable requirements.

E. The layout, pattern, and relationship of paving joints to fixtures and project formed details.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Concrete pavers shall be delivered to the site in steel banded, plastic banded, or plastic wrapped cubes capable of transfer by fork lift or clamp lift. The pavers shall be unloaded at the job site in such a manner that no damage occurs to the product.

B. Store and protect materials free from mud, dirt and other foreign materials.

C. Delivery and paving schedules shall be coordinated in order to minimize interference with normal use of buildings adjacent to paving.

1.05 ENVIRONMENTAL CONDITIONS

A. Aggregate or pavers shall not be installed during heavy rain or snowfall.

B. Aggregate and pavers shall not be installed over frozen base materials.

PART 2 PRODUCTS

2.01 CONCRETE PAVERS

A. Concrete Pavers: Architectural Pavers Style - Turfstone; Unilock New York, Inc., Brewster, NY.
   1. Color: Natural.
   2. Size: 23-5/8” x 15-3/4” x 3-1/8”.

B. Pavers shall meet the minimum material and physical properties set forth in ASTM C 936, Standard Specification for Interlocking Concrete Paving Units. Efflorescence shall not be a cause for rejection.

C. Pigment in concrete pavers shall conform to ASTM C 979. ACI Report No. 212.3R

provides guidance on the use of pigments.

2.02 PERMEABLE JOINT OPENING AGGREGATE

A. The permeable joint opening aggregate shall conform to ASTM C 33 and the grading requirements as shown in Table 1.

TABLE 1
PERMEABLE JOINT OPENING AGGREGATE
GRADING REQUIREMENTS
(GRANITE CHIPS)

ASTM C 33	
Sieve Size	**Percent Passing**
1/4 in	97 to 100
No. 4	70 to 83
No. 8	37 to 50
No. 16	0 to 12

2.03 PERMEABLE SETTING BED AGGREGATE

A. The permeable setting bed aggregate shall conform to ASTM C 33 and the grading requirements of ASTM D 448 No. 8 as shown in Table 2.

TABLE 2
PERMEABLE SETTING BED AGGREGATE
GRADING REQUIREMENTS

ASTM No. 8	
Sieve Size	**Percent Passing**
1/2 in	100
3/8 in	85 to 100
No. 4	10 to 30
No. 8	0 to 10
No. 16	0 to 5

2.04 PERMEABLE BASE AGGREGATE

A. The permeable base aggregate shall conform to ASTM C 33 and the grading requirements of ASTM D 448 No. 57 as shown in Table 3.

TABLE 3
PERMEABLE BASE AGGREGATE
GRADING REQUIREMENTS

ASTM No. 57	
Sieve Size	**Percent Passing**
1-1/2 in	100
1 in	95 to 100
1/2 in	25 to 60
3/8 in	85 to 100
No. 4	0 to 10
No. 8	0 to 5

2.05 PERMEABLE SUBBASE AGGREGATE

A. The permeable subbase aggregate shall conform to ASTM C 33 and the grading requirements of ASTM D 448 No. 2 as shown in Table 4.

TABLE 4
PERMEABLE SUBBASE AGGREGATE
GRADING REQUIREMENTS

ASTM No. 2	
Sieve Size	**Percent Passing**
3 in	100
2-1/2 in	90 to 100
2 in	35 to 70
1-1/2 in	0 to 15
3/4 in	0 to 5

Note: For all aggregates, provide washed, clean, have zero plasticity, free from deleterious or foreign matter, crushed, angular rock and contain no No. 200 sieve size aggregate materials used in the construction of permeable pavement.

2.06 GEOTEXTILE

A. Provide Geotextile material conforming to the following performance characteristics, measured per the test methods referenced:
   1. 4 oz., nonwoven needle punched geotextile composed of 100% polypropylene

staple fibers that are inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids.
2. Grab Tensile Strength: ASTM D 4632: 115 lbs.
3. Grab Tensile Elongation: ASTM D 4632: 50%
4. Trapezoidal Tear: ASTM D 4533: 50 lbs.
5. Puncture: ASTM D 4833: 65 lbs.
6. Apparent Opening Size: ASTM D 4751: 0.212 mm, 70 U.S. Sieve
7. Permittivity: ASTM D 4491: 2.0 sec -1
8. Flow Rate: ASTM D 4491: 140 gal/min/s.f.

2.07 EDGE RESTRAINTS

A. Concrete Edge Restraint as indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas indicated to receive paving for compliance with requirements for installation tolerances and other conditions affecting performance for the following items before placing the Permeable Concrete Pavers.
1. Verify that subgrade preparation, compacted density and elevations conform to specified requirements.
2. Verify that Geotextiles, if applicable, have been placed according to drawings and specifications.
3. Verify that Permeable Base and Subbase Aggregate materials, thickness, compacted density, surface tolerances and elevations conform to specified requirements.
4. Provide written density test results for soil subgrade, Permeable Base and Subbase Aggregate materials to the Owner's Representative, General Contractor and paver installation subcontractor.
5. Verify location, type, and elevations of edge restraints, concrete collars around utility structures, and drainage inlets.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
1. Beginning of bedding sand and paver installation signifies acceptance of base and edge restraints.

3.02 SITE PREPARATION

A. Verify that the subgrade soil is free from standing water.

B. Stockpile Permeable Setting Bed, Joint, Base and Subbase Aggregate materials such that they are free from standing water, uniformly graded, free of any organic material or sediment, debris, and ready for placement.

C. Remove any excess thickness of soil applied over the excavated soil subgrade to trap sediment from adjacent construction activities before placing the Geotextile and Permeable Subbase Aggregate materials.

D. Keep area where pavement is to be constructed free from sediment during entire job. Remove and replace all Geotextile, Permeable Joint, Setting Bed, Base and Subbase Aggregate materials contaminated with sediment with clean materials.

E. Complete all subdrainage of underground services within the pavement area in conjunction with subgrade preparation and before the commencement of Permeable Subbase Aggregate construction.

F. Prevent damage to underdrain pipes, overflow pipes, observation wells, or inlets and other drainage appurtenances during installation. Report all damage immediately.

G. Compact soil subgrade uniformly to at least 90 percent of Standard Proctor Density per ASTM D 698 for pedestrian areas. Compact soil subgrade uniformly to at least 95 percent Modified Proctor per ASTM D 1557 for vehicular areas.

H. Proof-roll prepared subgrade according to requirements in Specification Section 31 00 00 "Earthwork" to identify soft pockets and areas of excess yielding. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting and replace with compacted backfill or fill as directed.

I. Under no circumstances shall further pavement construction proceed until the subgrade has been inspected and approved by the Owner's Representative.

3.03 INSTALLATION

A. Edge Restraints
   1. Provide edge restraints as indicated.
      a. Install job-built concrete edge restraints to comply with requirements in Specification Section 03 30 00 "Cast-in-Place Concrete."
      b. Provide concrete edge restraint along the perimeter of all paving as specified. Install the face of the concrete edge restraint, where it abuts pavers vertical down to the subbase.
      c. Construct concrete edge restraint to dimensions and level specified and support on a compacted subbase not less than 6 in (150 mm) thick.

B. Geotextiles

1. Provide separation geotextile on bottom and sides of prepared soil subgrade. Secure in place to prevent wrinkling or folding from equipment tires and tracks.
2. Overlap ends and edges a minimum of 18 in. (450 mm) in the direction of drainage.

C. Permeable Base and Subbase Aggregate
1. Provide the Permeable Subbase Aggregate in uniform lifts not exceeding 6 in., (150 mm) loose thickness and compact to at least 95 percent as per ASTM D 4254 to depths as indicated.
2. Compact the Permeable Subbase Aggregate material with at least two passes in the vibratory mode then at least two in the static mode with a minimum 10 ton vibratory roller until there is no visible movement. Do not crush aggregate with the roller.
3. Tolerance: Do not exceed the specified surface grade of the compacted Permeable Subbase Aggregate material more than ±3/4 in. (20 mm) over a 10 ft. (3 m) long straightedge laid in any direction.
4. Provide the Permeable Base Aggregate material in uniform lifts not exceeding 6 in. (150 mm) over the compacted Permeable Subbase Aggregate material and compact to at least 95 percent as per ASTM D 4254 to depths as indicated.
5. Compact the Permeable Base Aggregate material with at least two passes in the vibratory mode then at least two in the static mode with a minimum 10 ton vibratory roller until there is no visible movement. Do not crush aggregate with the compaction device.
6. Tolerance: Do not exceed the specified surface grade of the compacted Permeable Base Aggregate material more than ±1/2 in. (13 mm) over a 10 ft. (3 m) long straightedge laid in any direction.
7. Grade and compact the upper surface of the Permeable Base Aggregate material sufficiently to prevent infiltration of the Permeable Setting Bed Aggregate material both during construction and throughout its service life.

D. Permeable Setting Bed Aggregate
1. Provide, spread and screed Permeable Setting Bed aggregate evenly over the Permeable Base Aggregate course.
   a. Protect screeded Permeable Setting Bed Aggregate from being disturbed.
   b. Screed only the area which can be covered by pavers in one day.
   c. Do not use Permeable Setting Bed Aggregate material to fill depressions in the base surface.
2. Keep moisture content constant and density loose and constant until Concrete Pavers are set and compacted.
3. Inspect the Permeable Setting Bed Aggregate course prior to commencing the placement of the permeable concrete pavers.
4. Inspect the Setting Bed Aggregate course prior to commencing the placement of the Permeable Concrete Pavers. Acceptance of the Setting Bed Aggregate occurs with the initiation of Permeable Concrete Paver placement.

E. Permeable Concrete Pavers
1. Replace unit pavers with chips, cracks, voids, discolorations, and other defects that might be visible in finished work.
2. Mix Concrete Pavers from a minimum of three (3) bundles simultaneously drawing the paver vertically rather than horizontally, as they are placed, to produce uniform blend of colors and textures.
3. Exercise care in handling face mix pavers to prevent surfaces from contacting backs or edges of other units.
4. Provide Permeable Concrete Pavers using joint pattern as indicated. Adjust joint pattern at pavement edges such that cutting of edge pavers is minimized. Cut all pavers exposed to vehicular tires no smaller than one-third of a whole paver.
5. Use string lines or chalk lines on Permeable Setting Bed aggregate to hold all pattern lines true.
6. Set surface elevation of pavers 1/8 in. (3 mm) above adjacent drainage inlets, concrete collars or channels.
7. Place units hand tight against spacer bars. Adjust horizontal placement of laid pavers to align straight.
    a. When installation is performed with mechanical equipment, use only unit pavers with spacer bars on sides of each unit.
8. Provide space between paver units of 1/32 in. (1 mm) wide to achieve straight bond lines.
9. Prevent joint (bond) lines from shifting more than ±1/2 in. (±15 mm) over 50 ft. (15 m) from string lines.
10. Fill gaps between units or at edges of the paved area that exceed 3/8 inch (10 mm) with pieces cut to fit from full-size unit pavers.
11. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.
12. Prevent all traffic on installed pavers until Permeable Joint Aggregate has been vibrated into joints. Keep skid steer and forklift equipment off newly laid pavers that have not received initial compaction and Permeable Joint Aggregate material.
13. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 5000-lbf (22-kN) compaction force at 80 to 90 Hz. Perform at least three passes across paving with vibrator. Vibrate under the following conditions:
    a. After edge pavers are installed and there is a completed surface.
    b. Compact installed concrete pavers to within 6 feet (1,800 mm) of the laying face before ending each day's work. Cover pavers that have not been compacted and leveling course on which pavers have not been placed, with nonstaining plastic sheets to prevent Permeable Setting Bed Aggregate from becoming disturbed.
14. Protect face mix Concrete Paver surface from scuffing during compaction by utilizing a urethane pad.

15. Remove any cracked or structurally damaged pavers and replace with new units prior to installing Permeable Joint Opening Aggregate material.
16. Provide, spread and sweep Permeable Joint Opening Aggregate into joints immediately after vibrating pavers into Permeable Setting Bed course until full. Vibrate pavers and add Permeable Joint Aggregate material until joints are completely filled, then remove excess material. This will require at least 4 passes with a plate compactor.
17. Remove excess Permeable Joint Aggregate broom clean from surface when installation is complete.

3.04 FIELD QUALITY CONTROL

A. Verify final elevations for conformance to the drawings after sweeping the surface clean.
   1. Prevent final Concrete Paver finished grade elevations from deviating more than ±3/8 in. (±10 mm) under a 10 ft (3 m) straightedge or indicated slope, for finished surface of paving.

B. Lippage: Paver-to-Paver Lippage:
   1. No greater than 1/8 inch (3 mm) difference in height between adjacent pavers.

END OF SECTION 32 14 13

SECTION 32 17 23 - SIGNS AND PAVEMENT MARKINGS

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. This Section includes:
   1. Signage.
   2. Epoxy pavement markings applied to asphalt pavement.

1.3 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.

B. ICC A117.1 - Accessible and Usable Buildings and Facilities; International Code Council; 2009 (ANSI).

C. New York State Department of Transportation (NYSDOT) September 1, 2021 Standard Specifications.

D. U.S. DOT Federal Highway Administration Manual on Uniform Traffic Control Devices.

1.4 SUBMITTAL

A. Shop Drawings:
   1. Signs: Show shop drawings, not necessarily to scale, but sufficient enough in detail to show color, wording, lettering size and style, overall sign size, construction details and installation details for each type of sign.
   2. Pavement markings: Indicate pavement markings, colors, lane separations, and dimensions to adjacent work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.

B. Store tape adhesive at normal room temperature.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 55 deg F and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 TRAFFIC SIGNS

A. Construction Materials: Traffic control signs shall conform to the standards outlined in the MUTCD.

B. Posts: Galvanized Steel.

2.2 EPOXY REFLECTORIZED PAVEMENT MARKINGS

A. The epoxy marking material should be hot-applied by spay methods onto bituminous and Portland cement concrete pavement surfaces at the thickness and width shown on the Contract Documents. Following an application of glass beads, the cured epoxy marking shall be an adherent reflectorized stripe.

B. General
1. All pavement markings and patterns shall be placed as shown on the Contract Documents and in accordance with the MUTCD.
2. Before any pavement marking work is begun, a schedule of operations shall be submitted for the approval of the Engineer.
3. At least five (5) days prior to starting striping, the Contractor shall provide the Engineer with the epoxy manufacturer's written instructions for use. These instructions shall include, but not be limited to, material mixing ratios and application temperatures.
4. When pavement markings are applied under traffic, the Contractor shall provide all necessary flags, markers, signs, etc. in accordance with the MUTCD to maintain and protect traffic, and to protect marking operations and the markings until thoroughly set.
5. The application of pavement markings shall be done in the general direction of traffic. Striping against the direction of traffic flow shall not be allowed.
6. The Contractor shall be responsible for removing, to the satisfaction of the Engineer, all tracking marks, spilled epoxy, and epoxy markings applied in unauthorized areas.
7. When necessary the Contractor shall establish marking line points at 30 foot intervals throughout the length of the pavement or as directed by the Engineer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that pavement is dry and in suitable condition to begin pavement marking according to manufacturer's written instructions.

B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 SIGNS

A. Erect signs in their designated locations, as indicated and in accordance with the approved shop drawings and the applicable requirements of NYSDOT 2021 Standard Specifications (Section 645).

3.3 EPOXY REFLECTORIZED PAVEMENT MARKINGS

A. Atmospheric Conditions: Epoxy pavement markings shall only be applied during conditions of dry weather and on substantially dry pavement surfaces. At the time of installation the pavement surface temperature shall be a minimum of 50°F and the ambient temperature shall be a minimum of 50°F and rising. The Engineer shall be the sole determiner as to when atmospheric conditions and pavement surface conditions are such to produce satisfactory results.

B. Surface Preparation
   1. The Contractor shall clean the pavement and existing durable markings to the satisfaction of the Engineer.
   2. Surface cleaning and preparation work shall be performed only in the area of the epoxy markings application.
   3. At the time of application, all pavement surfaces and existing durable markings shall be free of oil, dirt, dust, grease, and similar foreign materials. The cost of cleaning these contaminants shall be included in the bid price of this item.
   4. In addition, concrete curing compounds on new Portland cement concrete surfaces and existing painted pavement markings on both concrete and bituminous pavement surfaces shall be cleaned and included in the bid price of this item.

C. Application:
   1. Epoxy reflectorized pavement markings shall be placed at the width, thickness, and pattern designated by the Contract Documents.
   2. Marking operations shall not begin until applicable surface preparation work is completed and approved by the Engineer, and the atmospheric conditions and pavement surface temperature are acceptable to the Engineer.
   3. Pavement markings shall be applied by the following simultaneous operation:
      a. The pavement surface is air-blasted to remove dirt and residues.
      b. The epoxy resin, mixed and heated in accordance with the manufacturer's recommendations, is uniformly hot-sprayed onto the pavement surface at the minimum specified thickness.
      c. Reflective glass spheres are injected into, or dropped onto, the liquid epoxy marking at a minimum rate of 20 lb./gal of epoxy resin.

3.4 PROTECTING AND CLEARING

A. Protect pavement markings from damage and wear during remainder of construction period.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 32 17 23

SECTION 32 31 13
CHAIN LINK FENCE

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 RELATED SECTIONS

A. Related Sections include:
   1. Section 310000 – Earthwork.

1.3 DEFINITIONS

A. Height of Fence: Distance measured from the top of concrete footing to the top of fabric. Fences with buried fabric measured from finished grade to the top of fabric.

1.4 REFERENCES

A. Comply with ASTM A 53 for requirements of Schedule 40 piping.

B. Welding Standards: "Structural Welding Code - Steel, AWS D1.1" or "Structural Welding Code - Sheet Steel, AWS D1.3", as applicable, by the American Welding Society (AWS Codes).

C. Materials and Finishes Standard: ANSI/BHMA A156.18-2012, "American National Standard for Materials and Finishes".

1.5 SUBMITTAL

A. Shop Drawings: Complete detailed drawings for each height and style of fence and gate required. Include separate schedule for each listing all materials required and technical data such as size, weight, and finish, to ensure conformance to specifications.

B. Product Data: Manufacturer's catalog cuts, specifications, and installation instructions for each item specified.

C. Quality Control Submittals:
   1. Test Reports: Security coils test procedure report.
   2. Certificates: Affidavit required under Quality Assurance Article.

1.6 QUALITY ASSURANCE

A. Comply with standards of the Chain Link Fence Manufacturer's Institute.

B. Provide steel fence and related gates as a complete compatible system including necessary erection accessories, fittings, and fastenings.

C. Posts and rails shall be continuous without splices.

D. Concrete batching plants shall be currently approved as concrete suppliers by the New York State Department of Transportation.

PART 2 - PRODUCTS

2.1 STEEL FRAMEWORK (FOR FENCES 8'-0" HIGH)

A. End Posts, Corner Posts and Gate Posts
   1. Black PVC coated.
   2. Line Post: 2.375 inches OD, Group 1A Grade 50, (Schedule 40).
   3. Corner & Gate Post: 3.50 inches OD, Group 1A Grade 50, (Schedule 40).

B. Mesh: Black PVC coated.
   1. 2" mesh, 9 gauge.

2.2 SWING GATE FRAMES

A. Assemble gate frames by welding or with special steel fittings and rivets for rigid connections. When width of gate leaf exceeds 10 feet, install mid-distance vertical bracing of the same size and weight as frame members. When either horizontal or vertical bracing is not required, provide truss rods as cross bracing to prevent sag or twist.

2.3 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Rails and Post Braces:
   1. Pipe: 2 inches OD, Group 1A Grade 50 (Schedule 40).
   2. Refer to plan for required spacing.

B. Fittings and Post Tops: Pressed Steel.

C. Stretcher Bars: as indicated on drawings.

D. Metal Bands (for securing stretcher bars): Pressed Steel, 12-gauge minimum thickness with beveled edges.

E. Wire Ties: Conform to American Steel Wire gauges.
1. For tying fabric to line posts, rails and braces: 9-gauge (.1483 inch) steel wire.
2. For tying tension wire to fabric: 9-gauge (.1483 inch) galvanized steel hog rings.

F. Truss Rods: 3/8-inch diameter with threaded end to be utilized with a pressed steel industrial truss rod tightener.

G. Concrete: (Class F1 as defined by ACI 318-14 Section 19.3.1) Portland Cement concrete having a minimum compressive strength of 4,000 psi at 28 days, maximum water/cement ratio of 0.55, target air content of 5% +/- 1%. The design mix shall be procured from a NYSDOT approved concrete supplier. Retarding Admixture: ASTM C 494, Type D, Water-reducing and retarding, for use in hot weather concreting, and on the New York State Department of Transportation's current "Approved List".

H. Spiral Paper Tubes:
1. Sonotube by Sonoco Products Co., North Second St., Hartsville, SC 29550, (800) 377-2692.
2. Sleek/tubes by Jefferson Smurfit Corp., P.O. Box 66820, St. Louis, MO 63166, (314) 746-1100.

I. Cold Galvanizing Compound: Single component compound giving 93 percent pure zinc in the dried film, and meeting the requirements of DOD-P-21035A (NAVY).

2.4 FINISHES

A. Steel Framework:
1. Polyvinyl Chloride (PVC): Black plastic finish, fusion bonded to galvanized metal, minimum thickness 10 mils.

B. Fabric:
1. Polyvinyl Chloride (PVC) Finish: Black plastic, fusion bonded to galvanized wire, breaking strength, 1290 pounds, minimum thickness 7 mils. Coating in compliance with ASTM F688 Class 2b.

C. Fence and Gate Hardware, Miscellaneous Materials, Accessories:
1. PVC coated, per manufacturer's standards.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Space posts equidistant in the fence line with the post spaced as indicated on drawings.

B. Setting Posts in Earth: Drill holes for post footings. If existing grade at the time of installation is below finished grade, provide spiral paper tubes to contain concrete to finish grade elevation. Set posts in center of hole and fill hole with concrete. Plumb and align posts. Vibrate or tamp concrete for consolidation. Finish concrete in a dome shape above finish grade elevation to shed water. Do not attach fabric to posts until concrete has cured a minimum of 7 days.

C. Setting Posts in Rock: Drill holes into solid rock one inch wider than post diameter. Set post to a depth indicated on drawings. Set posts into holes and fill annular space with shrink-resistant grout.

D. Locate corner posts at corners and at changes in direction. Use pull posts at all abrupt changes in grade and at intervals no greater than 500 feet. On runs over 500 feet, space pull posts evenly between corner or end posts. On long curves, space pull posts so that the strain of the fence will not bend the line posts.

E. Install top rail continuously through post tops or extension arms, bending to radius for curved runs. Install expansion couplings as recommended by fencing manufacturers.

F. Install bottom and intermediate rails in one piece between posts and flush with post on fabric side using special offset fittings where necessary.

G. Brace corner posts, pull posts, end posts, and gate posts to adjacent line posts with horizontal rails.

H. Diagonally brace corner posts, pull posts, end posts, and gate posts to adjacent line posts with truss rods and turnbuckles.

I. Attach fabric to security side of fence. Maintain a 2 inch clearance above finished grade except when indicated otherwise. Thread stretcher bars through fabric using one bar for each gate and end post and 2 for each corner and pull post. Pull fabric tight so that the maximum deflection of fabric is 2 inches when a 30 pound pull is exerted perpendicular to the center of a panel. Maintain tension by securing stretcher bars to posts with metal bands spaced 15 inches oc. Fasten fabric to steel framework with wire ties spaced 12 inches oc for line posts and 24 inches oc for rails and braces. Bend back wire ends to prevent injury. Tighten stretcher bar bands, wire ties, and other fasteners securely.

1. When fabric is indicated to be buried, the buried portion of fabric shall be separate from the main fence fabric. Overlap main fabric and buried fabric a minimum of 6 inches at the bottom rail, and secure with wire ties spaced 12 inches oc.

J. Position bolts for securing metal bands and hardware so nuts are located opposite the fabric side of fence. Tighten nuts and cut off excess threads so no more than 1/8 inch is exposed. Peen ends to prevent loosening or removal of nuts.
1. Secure post tops and extension arms with tamper-resistant screws.

K. Install gates plumb and level and adjust for full opening without interference. Install ground-set items in concrete for anchorage, as recommended by fence manufacturer. Adjust hardware for smooth operation and lubricate where necessary.

3.2 ADJUSTING

A. Gates: Adjust operative units and equipment to work freely and easily, free of binding, warp, excessive deflection, distortion, nonalignment, disruption, or malefaction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

END OF SECTION 32 31 13

SECTION 32 31 19.1 – DECORATIVE METAL FENCING & GATES [OMEGA II]

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Drawings and general provisions of the Contract, and Division 1 Specification Sections, apply to this Section.

B. Section Includes, without limitation, providing:
1. Custom decorative steel wire mesh fence panel / gate assemblies.

C. Extent, without limitation, includes: As shown on drawings.
1. Single mesh swing gate.
2. Fence assemblies.

D. Related Sections, without limitation, include:
1. Division 08 00 00 – Door and gate specialty egress, locking hardware, and cylinders.

1.2 SUBMITTALS

A. Comply with Division 01 General Requirements and submit for approval:
1. Product Data: Manufacturer's literature including installation instructions, use restrictions and limitations. Include information on mesh, framing, gates, hardware, finishes and coordinate with work by others such as egress hardware.
2. Shop drawings: Large scale drawings for fabrication, installation and erections including plans, elevations, details, anchorages, connections and accessories along with head, jamb, sill and joining details. Provide templates for work installed by others.
   a. Field Measurements: Take accurate field measurements before fabrication and indicate same on shop drawings.
3. Initial Selection samples: Provide samples of color and material ranges.
4. Verification: Submit final samples of selected products. Include samples showing full variation of color and finish expected.
5. Maintenance Data: Provide recommended maintenance procedures.

B. Sustainability [LEED] Submittals: Submit documentation from manufacturer indicating compliance with LEED requirements for materials and products of this Section. Comply with requirements of Division 01 and submit information on required forms.

1.3 QUALITY ASSURANCE

A. Comply with Division 01 requirements and governing codes and regulations.

B. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with specifciations from products from one of the following:
1. Metaltech – Omega, Inc.; www.omegafence.com/.
2. Ametco Manufacutring Corp.; www.ametco.com/.
3. American Fence Company; www.theamericanfencecompany.com/.
4. Approved equal.

B. Basis of design: Omega II Fence System

2.2 COATED STEEL FENCING / GATE ASSEMBLIES

A. Fence and gate panel construction:

1. Panels material: Welded wire mesh.
2. Wire: 6 gauge - 0.192" pre-galvanized steel wire, welded at each crossing to form rectangles of 2 x 6 inch (50 x 150 mm).
3. Cold rolled wire tensile strength: 75,000 psi.
4. Configuration: One end of vertical wires of panel exceed 1'' from last or the horizontal wire creating a spiked top or bottom depending of its position when installed. Other end is cut flush.
5. Panels folds: As required by height and type according to the table 2 below depending on the respective height of the panel.
6. Panel camber: Not to exceed 0.094'' (2.5 mm).
7. Height and width: As shown.

B. Posts and frames:
1. Material: Cold rolled from 1008 grade steel; meet ASTM 500 and ASTM A787.
2. Size: As shown; if not, for fences 3 inch square and gate frames 2 and 1.5 inches square.
3. Brackets, universal or U shapes: As required by application using manufacturer standard.
4. Caps: required, match material and finish.

C. Finishes: See below.

D. Carbon steel plate, pipe and bar: Comply with provisions of sections for miscellaneous metal fabrications and steel railings and provide hot dip galvanizing and shop priming with field finish per sections for Galvanizing, Shop coatings on galvanizing and painting.

E. Concrete for setting posts: As shown, comply with Division 03 specifications, in the absence of other indications, provide 3000 psi ready mix, and if subject to de-icing salts, 4000 psi concrete.

F. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.

G. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer for exterior applications.

2.3 GATES

A. Swing gate frames: Comply with ASTM F900 using galvanized square cold rolled steel tube 16 gage (1.6 mm) steel grade 1008.
1. Frame:
   a. Verticals: Tube steel 1.5 inch square [38 mm].
   b. Horizontals: Tubes steel 2 inch square [50] mm X 50 mm)
   c. Joints: Full penetration continuous welds ground smooth.
   d. Provide supplementary vertical when required.
2. Oversize gates where height or width exceeds 84 inches: Use vertical tubes of 11 gage [3.0mm] or heavier.
3. Frame caps: Required.

B. Mesh: Match requirements for fence above.

C. Gate hardware:
1. Gate hardware: Comply with ASTM F900 for hinges, latch, drop rods, using hot-dip galvanized steel, and sized to assure proper gate operation. Non moving parts shall be powder coated.
2. Hinge: structurally designed to support gates without deformation during opening and closing.
3. Latch: Clamp-on gravity system, self latching.
4. Gate Keeper for double leafed models: Gate keeper consist of mechanical device with gravity-lock system that fasten each gate leaf when in full open position.
   a. Keyed locks: Provide keyed locks if shown or specified elsewhere.
5. Locking: As specified in Division 08 for door hardware.
6. Egress: As specified in Division 08 for door hardware.

D. Finish: See below.

2.4 MISCELLANEOUS STEEL COMPONENTS

A. Provide hot rolled steel plated with custom patterned cut outs shown. Hot dip galvanize and shop coat steel as specified. Panel shall be of sufficient thickness to be plane and free of buckles, warping or irregularities. Where this is impractical for hot dipped, hot rolled steel, use aluminum plate not less than 0.125 inch thick and provide powder coated finish complying the section 05 08 00 Type 5.

2.5 FINISHES

A. Zinc coating:
1. Wire mesh coating: 0.5 oz./sq.ft. (150 g/m2) zinc per ASTM A 641 Class 1
2. Fence posts, swing gate frame and posts zinc coat: Galvalum process with a minimum of 0.9 oz/sq.ft.(275 g/m2) as per ASTM A653 G90.

B. Polyester coating to be minimum 4 mils applied by an electrostatic method. Coating shall cover surfaces of wire and post sections. Coating shall be capable of withstanding the following tests:
1. Mechanical adhesion test as per ASTMD 3359 (1990) - Method B.
2. Shock resistance tests as per ASTM D 2794 (1990).
3. Salt spray testing with a min. of 1,000 hrs without red rust appearance, as per ASTM B 117 (1990).
4. Humidity resistance in a weather meter chamber as per ASTM D 2247 (1988).
5. Exposure to ultraviolet light with exposure of 1000 hours using apparatus Type E and 63°C as per ASTM D1499

C. Polyester surface coating colors: Architect selected from full manufacturer range. Provide custom color if scheduled or indicated.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the provisions of Section 01 70 00 - especially requirements related to:
1. Inspection and examination.
2. Tolerances and measurement.
3. Approvals, inspections and filed quality control.
4. Layout.
5. Adjusting.
6. Cleaning.
7. Protection.

B. Install materials and systems in accordance with manufacturer's instructions, limitations and restrictions and approved submittals. Install materials and systems in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.

3.2 INSTALLATION - FENCING

A. Terminal Posts: Locate terminal end, corner, and gate posts at changes in horizontal or vertical alignment as indicated on Drawings.

B. Square post installation for 2 to 3 inch sized posts:
1. Post hole size: Minimum of 8 inches in diameter and 42 inches deep.
2. After concrete is set, install mesh sections using universal bracket kits of required size, installed flush with horizontal wire of panel without a ga).
3. Post spacing: Approximately 98 inches.

C. Step fence sections at slopes.

D. Mesh Panels: Vertical wire extensions pointing up for security or down for safety]. Install fence panel a minimum distance of 1.25 inchesand maximum of 2 inches) above ground surface.

E. Apply a zinc rich primer to exposed ends of trimmed or cut components and finish with matching touch-up paint supplied by manufacturer.

3.3 PLACING CAST IN PLACE CONCRETE & GROUTING

A. Comply with ACI 301 for cast-in-place concrete and Division 03 00 00. Grout and anchor work in securely place. Pitch surfaces to drain water away from metals.

3.4 GATE INSTALLATION

A. Concrete Set Gate Posts: Comply with the following:
1. Drill holes in firm, undisturbed or compacted soil with a diameter 4 times greater than outside dimension of post, and depths approximately 6 in. (150 mm) deeper than frost level.
2. Excavate deeper as required for adequate support in soft and loose soils, and for posts with heavy lateral loads.
3. Set post bottom 36 inches below surface when in firm, undisturbed soil.
4. Place concrete around posts in a continuous pour, tamp for consolidation.
5. Trowel finish around post and slope to direct water away from posts.
6. Check each post for vertical and top alignment, and maintain in position during placement and finishing operations.

B. Install gates perfectly horizontal and leveled (at junction), plumb, and secure for full opening without interference.

C. Attach hardware so nuts inside property ensure assembly is tamper-proof to prevent unauthorized removal. Install ground-set items in concrete for anchorage.

D. Adjust hardware for smooth operation and lubricate where necessary to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Verify that latches and locks engage accurately and securely without forcing or binding.

END OF SECTION

SECTION 32 32 15

PRECAST MODULAR BLOCK RETAINING WALL SYSTEM

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Work governed by this section, as shown or specified shall be in accordance with the requirements of the Contract Documents and the New York State Building Code (International Building Code 2018 edition).

1.02 DESCRIPTION

A. 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.

B. The contractor is solely responsible for safety. The Engineer and Owner shall not be responsible for means or methods of construction or for safety of workers or the public.

1.03 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 D6637 - Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method

L. ASTM D6638 - Standard Test Method for Determining Connection Strength Between Geosynthetic Reinforcement and Segmental Concrete Units (Modular Concrete Blocks)

M. ASTM D6916 - Standard Test Method for Determining the Shear Strength Between Segmental Concrete Units

N. Geotechnical Report: A Geotechnical Engineer engaged by the Owner has prepared a report entitled Report, Geotechnical Investigation, Proposed Animal Shelter, Pomona, Rockland County, New York, prepared by Melick-Tully & Associates, dated September 14, 2021. A copy of the report shall be available to the Contractor for reference. Boring and other in situ test logs are made available to the Contractor for information only. Conditions are not intended as representations or warranties of accuracy or continuity between borings. The Owner will not be responsible for interpretation conclusions drawn from this data by the Contractor.

1.04 SUBMITTALS

A. Submit for review shop drawings for the retaining wall system prepared by a Structural Engineer Licensed by the State of New York. The shop drawings shall indicate the layout, height, and construction details of the retaining wall system. Design calculations shall also be submitted. Minimum safety factors for design shall be as follows:

	Gravity Wall	Geosynthetic Reinforced Wall
Sliding	1.5	1.5
Overturning	1.5	2.0
Bearing	2.0	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's representative. The color sample may be part of the completed

wall, but shall be located in an inconspicuous area.

C. If an alternate geosynthetic reinforcement is included in the contractor's design, submit manufacturer's literature and test data for geosynthetic to be used in the reinforced wall system. Test data shall include connection strength data for geogrid with precast modular units determined in accordance with ASTM D6638, as well as geogrid tensile strength and creep data in accordance with ASTM D4595 and ASTM D5262.

D. Submit grain size test results for aggregates to be used for the wall base and for unit fill.

E. 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.

1.05 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 PRODUCTS

2.01 WALL UNITS

A. Precast modular blocks shall be Stone Strong units manufactured under license from Stone Strong LLC., or 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.

2.02 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	Percent Passing
1-1/4 in	80 to 100
3/4 in	50 to 90
No. 4	0 to 40
No. 200	0 to 10

B. The contractor may substitute concrete with a minimum 28-day compressive strength of 3,000 psi for the granular base material. Concrete may be placed full thickness or as a topping over a compacted granular base. If used as a topping, the concrete shall have a minimum thickness of 3 inches.

2.03 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	Percent Passing
1-1/2 in	100
3/4 in	50 to 90
No. 4	0 to 10
No. 8	0 to 5

2.04 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	Percent Passing
3/4 in	100
No. 200	0 to 5

B. 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 shall not be used. Frozen soils, excessively wet or dry soils, debris, and deleterious materials shall not be used.

2.06 DRAIN TILE

A. Drain tile shall be perforated or slotted PVC or corrugated HDPE pipe. The drain tile shall be connected to storm drains or daylighted at low points and/or periodically along the wall alignment. The configuration of the drain tile and outlets shall be provided on the shop drawings.

PART 3 EXECUTION

3.01 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.

3.02 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.

3.03 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

4.01 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.

4.02 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 32 32 15

SECTION 32 91 00

SOIL PREPARATION AND MIXES

PART 1 - GENERAL

1.1 SECTION SUMMARY

A. Testing off-site borrow soil, existing topsoil and amendment materials for approved use in planting soil mixes. Verification testing of on-site sub-soils.

B. Furnishing material from approved off-site source(s) as a base component for planting soil mixes and furnishing other soil amendment materials.

C. Amending, preparing, and mixing planting soils for plant areas.

D. Placing, spreading, and fine grading pre-mixed planting soil material of the type(s) indicated for plant areas.

E. Protecting all plant mix installations with snow fencing, filter fabric, or other approved means, over the surface area plant bed installations, until substantial completion.

F. Protection of finished paving, light poles utility or other finished work by means of wooden protection boards, or other approved means, over the area of construction concurrent with any and all construction operations.

1.2 RELATED DOCUMENTS

A. Section 329300 – Landscape Planting

B. Section 329200 – Lawns And Grasses

C. Section 312000 – Earthwork

D. Construction Drawings and Documents

1.3 SUBMITTALS

A. Refer to and comply with Section 32 00 00, General Conditions, for procedures and additional submittal criteria.

B. Product Data: Submit technical descriptive data for each manufactured or packaged product of this Section. Include manufacturer's product testing and analysis and installation instructions for manufactured or processed items and materials.

C. Locations: Submit locations of material sources. Submit location of mixing sites.

D. Certificates:

1. Submit certified analysis for each soil treatment, amendment, and fertilizer material specified and as used. Include guaranteed analysis and weight for packaged materials.

E. Test Reports; Submit written reports of each sample tested. Each report shall include the following as a minimum and such other information required specific to material tested:

1. Date issued.

2. Project Title and names of Contractor and supplier.

3. Testing laboratory name, address and telephone number, and name(s), as applicable, of each field and laboratory inspector.

4. Date, place, and time of sampling or test, with record of temperature and weather conditions.

5. Location of material source.

6. Type of test.

7. Results of tests including identification of deviations from acceptable ranges. Identify any toxic substance(s) harmful to plant growth or life.

F. Samples:

1. Leaf mold, each source, 5 lb. packaged.

2. Base material, each source, 5 lb. packaged.

3. Each mix type specified, 5 lb. packaged.

G. Statement(s) of Qualifications: Submit within 45 days of notice to proceed to confirm qualifications as specified in Article 1.4, herein.

H. Schedule and Protection Plan: Submit a detailed plan for scheduling and sequencing of all contract work and for protection of soil mixes and other completed work including coordination with contractors requiring access through the site. Indicate with schedules and plans the utilization of soil mix and subsoil protection measures (filter fabric and snow fencing) over the surface area of plant bed installations, until substantial completion. Indicate with schedules and plans the utilization of finished work protection measures (wooden protection boards or other approved methods) over the work area of construction operations concurrent with all construction operations until substantial completion.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Installation and maintenance foreman on the job shall be competent English-speaking supervisor(s), experienced in landscape installation and maintenance. Perform work with personnel totally familiar with planting soil preparation and planting installations under the supervision of a foreman experienced with landscape work.
2. Agricultural Chemist: Experienced person or persons employed by public or private soils testing laboratory, qualified and capable of performing tests, making soil recommendations, and issuing reports as specified. Testing Laboratory and Agricultural Chemist shall be as approved by the Landscape Architect.

B. References:

1. Association of Official Agricultural Chemists.

2. American Society for Testing and Materials (ASTM) using test criteria as specified or required by other references.

C. Pre-installation Conferences: Person(s) responsible for soil preparation and mixes of this Section shall attend Pre-installation Conference(s) to coordinate with work of other sections. Refer to and comply with review and Conference criteria in Sections 31 00 00, 32 92 00, and 32 93 00.

D. Inspections and Testing:

1. Soil, leaf mold, and other material testing and soil mix testing required in this Section or additionally required by Owner's Representative shall be furnished and paid for by Contractor.

2. Owner's Representative or Landscape Architect reserve the right to take and analyze at any time such additional samples of materials as deemed necessary for verification of conformance to specification requirements. Contractor shall furnish samples for this purpose upon request and shall perform testing as requested.

1.5 REGULATORY REQUIREMENTS

A. Comply with all rules, regulations, laws and ordinances of local, state and federal authorities having jurisdiction Provide labor, materials, equipment and services necessary to make work comply with such requirements without additional cost to Owner.

B. Procure and pay for permits and licenses required for work of this section.

1.6 PROJECT/SITE CONDITIONS

A. Acquaintance With Existing Site Conditions:

1. Through study of all Contract Documents and by careful examination of the site, become informed as to the nature and location of the work, the nature of surface and subsurface soil conditions, the character, quality and quantity of the materials to be encountered, the character of equipment and facilities needed preliminary to and during the prosecution of the work, the general and local conditions, and all other matters which can in any way affect the work.

2. Investigate the conditions to public thoroughfares and roads as to availability, clearances, loads, limits, restrictions, and other limitations affecting transportation to, ingress and egress of this work site. Conform to all governmental regulations in regard to the transportation of materials to, from, and at the job site, and secure in advance such permits as may be necessary.

3. Should the Contractor, in the course of work, find any discrepancies between Contract Drawings and physical conditions or any omissions or errors in Drawings, or in layout as furnished by the Owner, it will be Contractor's duty to inform the Landscape Architect immediately in writing for clarification. Work done after such discovery, unless authorized by the Landscape Architect, shall be done at the Contractor's risk.

B. Environmental Requirements:

1. Perform both off site mixing and on-site soil work only during suitable weather conditions. Do not disc, rototill, or work soil when frozen, excessively wet, or in otherwise unsatisfactory condition.

2. Soil mixes shall not be handled, hauled, or placed during rain or wet weather or when wet near or above field capacity.

C. Sequencing and Scheduling: Adjust, relate together, and otherwise coordinate work of this Section with work of Project and all other Sections of Project Specifications.

1.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Packaged Materials: Deliver packaged materials to the location where soils are to be mixed, in unopened bags or containers, each bearing the name, guarantee, and trademark of the producer, material composition, manufacturers' certified analysis, and the weight of the materials Retain packages for the Construction Manager or Owner's Representative.

B. Soil or amendment materials stored on site temporarily in stockpiles prior to placement shall be protected from intrusion of contaminants and erosion. All temporary storage means and methods shall be approved by Owner's Representative.

C. After mixing, soil materials shall be covered with a tarpaulin until time of actual use.

PART 2 - PRODUCTS

2.1 PLANT MIX MATERIALS

A. General:

1. All plant mix materials shall fulfill the requirements for new plant mixes as specified.

2. Samples of individual components of plant mixes and also blended plant mixes shall be submitted by the Contractor for testing and analysis to the approved testing laboratory. Include verification testing of on-site sub-soils. Comply with specific material requirements specified.

   a. No base component material for plant mix shall be used until certified test reports by an agricultural chemist have been received and approved by Landscape Architect.

   b. As necessary, make any and all soil mix amendments and resubmit test reports indicating amendments until approved.

3. Owner's Representative may request additional testing by Contractor for confirmation of mix quality at any time until completion. See Article 1.4, herein for additional requirements.

4. All imported soil materials shall be free of hazardous substances as indicated in results of laboratory tests performed and signed by a certified soils laboratory. Laboratory test results shall be provided to landscape architect by contractor not less than 2 weeks prior to its intended use.

B. Base Component Material:

1. Base Component Material shall be a mix of Sand and Sandy Loam. Base component materials shall not be site salvaged unless approved by Landscape Architect.

2. Base Component Material shall be mixed by volume with 4 parts Sandy Loam to 5 parts Sand. The mix may need to be adjusted to reflect any slight variation of soils. Any and all modifications involving alternates must be approved by the Landscape Architect.

3. Test Base Component Materials, both individual components and mixed materials, for compliance with material specifications. These test criteria and results, when approved, shall establish the standard to which all subsequent Base Component Material tests must conform.

4. Prior to mixing Base Component Material with organic matter (leaf mold), have one (1) composite sample tested from each 500 c.y. of material intended for use in soil mixes of lawn and planting work.

a. Base Component Material shall meet specified requirements. The only allowable amendments to the Base Component Material will be for adjustment of nutrient levels and then only by means established by these specifications.

b. Perform the following tests and submit test reports. Failure to include any of the criteria stated below will be sufficient cause for rejection of the test reports.

1) Particle size analysis/distribution as defined below as well as with a hydrometer method.

2) Fertility analysis - pH, soluble salts, nitrate, phosphate, potassium, calcium and magnesium.

3) Organic matter content (% ovendry weight of soil).

4) Toxic substance content.

5) Material drainage rate.

5. Material Requirements, Sand:

a. Physical Analysis (Soil Texture):
1) Sieve Size: Passing Retained: Dimension Class
a) 1” 100.0: 0.0: Gravel
b) 1/4” 100.0: 0.0: Fine Gravel
c) # 10 96.6: 3.4: Very Coarse Sand
d) # 20 82.8: 13.8: Coarse Sand
e) # 40 38.4: 44.4: Coarse Sand
f) # 60 12.0: 26.4: Medium Sand
g) # 80 5.5: 6.5: Fine Sand
h) #100 3.7: 1.8: Very Fine Sand
i) #200 1.4: 2.3: Very Fine Sand
j) Pan : 1.4: Silt/Clay

2) Test results must be submitted for percent (%) retained as well as for percent (%) passing for all sieve sizes. Failure to include any of the aforementioned criteria will be cause for rejection of the test report.

b. Chemical Analysis:

1) Organic matter content (% ovendry weight of soil)

2) Soil reaction (pH) - 6.0 (±0.5)

3) Soluble salt content (Conductivity) - Less than 0.5 mm hos/cm for a 1:2 soil to water ratio.

4) Toxic substance content harmful to plant growth.

c. Material Drainage at a rate of 55 to 70% of the total volume of water within 3 minutes. Soil should be saturated prior to conducting test.

6. Material Requirements, Sandy Loam:

a. Physical Analysis (Soil Texture):

1) Sieve Size: % Passing Retained: Dimension Class
   a) 1” 100.0: 0.0: Gravel
   b) 1/4” 99.0: 1.0: Fine Gravel
   c) # 10 97.9: 1.1: Very Coarse Sand
   d) #20 88.0: 8.9: Coarse Sand
   e) # 40 58.2: 29.8: Coarse Sand
   f) #60 39.6: 18.6: Medium Sand
   g) #80 32.9: 6.7: Fine Sand
   h) #100 30.7: 2.2: Very Fine Sand
   i) #200 18.7: 12.0: Very Fine Sand
   j) Pan: 18.7: Silt/Clay

2) Test results must be submitted for percent (%) retained as well as for percent (%) passing for all sieve sizes. Failure to include any of the aforementioned criteria will be cause for rejection of the test report.

b. Chemical Analysis:

1) Organic matter content (% ovendry weight of soil)

2) Total content shall be within the range of 3 to 4%.

3) Soil reaction (pH) - 6.0 (±0.5)

4) Soluble salt content (Conductivity) - Less than 3.1 mm hos/cm for a 1:2 soil to water ratio.

5) Toxic substance content harmful to plant growth.

c. Hydrometer Testing:

1) Sand - 63.8%

2) Silt - 23.2%

3) Clay - 13.0%

7. Before base component material is used for mixing with amendments, handle and pile Base Component Material in the following manner:

a. Homogenize to make a uniform mix, free of subsoil lenses and other irregularities.

b. Aerate the base material to make a friable planting medium.

c. Separate out and remove all clay lumps, stones, stocks, roots, and other debris.

8. Material Requirements, Base Component Material (Combination of 5 parts Sand and 4 parts Sandy Loam) Material shall substantially conform to the following:

a. Physical Analysis (Soil Texture):
1) Sieve Size: % Passing Retained: Dimension Class
a) 1” 100.0: 0.0: Gravel
b) 1/4” 98.0: 1.2: Fine Gravel
c) # 10 96.0: 2.8: Very Coarse Sand
d) #20 84.6: 11.4: Coarse Sand
e) # 40 42.1: 42.5: Coarse Sand
f) #6018.9: 25.2: Medium Sand
g) #80 10.1: 8.8: Fine Sand
h) #100 6.9: 3.2: Very Fine Sand
i) #200 1.3: 5.6: Very Fine Sand
j) Pan: 1.3: Silt/Clay

b. Chemical Analysis:

1) Organic matter content (% ovendry weight of soil): 1.6

2) Soil reaction (pH): 5.3

3) Soluble salt content (Conductivity): 4 mm hos/cm.

c. Hydrometer Testing:

1) Sand-84.8

2) Silt - 10.0

3) Clay- 5.2

d. Percolation: 60% passing in 2 minutes, 40% retained.

C. Organic Matter:

1. Leaf Mold: Shredded leaf litter, composted for a minimum of one year (12 months) and tested to confirm the following characteristics:

a. The leaf mold must be free of debris such as plastic fragments, glass, and metal fragments.

b. The leaf mold must be free of stones larger than 1/2", large branches, and large roots.

c. Woodchips over 1" in length or diameter should be removed by screening.

d. The leaf mold should have a pH value measured as a 1: 5 dilute in the range from 6.5 - 7.2.

e. The soluble salts measurement (Electric Conductivity) should not exceed 0.5 millimhos/cm measured as a 1: 5 dilute.

f. The organic matter content should be from 60 - 90% by weight.

g. The carbon/nitrogen ratio should fall between 12: 1 and 25 :1.

h. Heavy metal content not to exceed (less than) the following indicated -amounts:
   1) Element: Acetate Extract: HCL Extract
      a) Iron: 0.5 ppm: 3.1 ppm
      b) Manganese: 0.5 ppm: 15.4 ppm
      c) Molybdenum: 0.4 ppm: 0.8 ppm
      d) Zinc: 0.2 ppm: 4.4 ppm
      e) Aluminum: 0.2 ppm: 1.2 ppm
      f) Boron: 1.1 ppm: 1.7 ppm
      g) Copper: None: 0.01 ppm
      h) Lead: 01 ppm: 0.4 ppm
      i) Selenium: None: 0.4 ppm
      j) Mercury: None: None
      k) Chromium: None: None
      l) Cadmium: None: 0.02 ppm
      m) Nickel: None: 0.04 ppm
      n) Cobalt: None: 0.05 ppm

   2) None = none detected = below detection limits of 0.01 ppm.

2. Test leaf mold material:

   a. For compliance with material specifications including organic matter, pH, and heavy metal content. Have one (1) composite sample tested for each new source of supply, each variable pile within each source of supply, and each 500 c.y. of material or as directed by Owner's Representative.

2.2 SOIL AMENDMENT MATERIAL

A. Ground Limestone: Ground Limestone as a soil amendment material will only be used pending results of analysis.

1. Provide a Ground Agricultural Limestone with a minimum of 88% of calcium and magnesium carbonates.

2. Ground Limestone material shall have a total 100% passing the 10 mesh sieve, minimum of 90% passing the 20 mesh sieve, and a minimum of 60% passing the 100 mesh sieve.

B. Herbicides: For possible use if there is seed germination on-site after sub-grade placement prior to planting mix installation or after subsequent plant mix installation. Under no circumstances are materials to be applied without specific instruction from the Landscape Architect, or Owner's Representative.

1. Herbicides shall be approved before use for type and rate of application by the Landscape Architect and by local and state agencies with jurisdiction.

2. Post emergent herbicide shall be Roundup, as manufactured by Monsanto Agricultural Products Company, C3NJ, St. Louis, MO 63166, or an approved equal.

C. Soil Amendments: incorporate thoroughly with top six (6) in. of lawn and planting areas per 1,000 square feet:

1. 6 cu. yd. Approved Organic Amendment

2. 30 lbs. 6-20-20 Commercial Fertilizer

3. 50 lbs. Dololite Lime

4. 10 lbs. Iron Sulfate

D. Controlled Release Fertilizer:

1. Type: Osmocote 17-6-12 plus minors.

2.3 PLANTING SOIL MIXES

A. Adequate quantities of mixed planting soil materials shall be provided to attain, after compaction and natural settlement, all design finish grades. Verify quantities for placement as specified in Sections 329200 and 329300 to suit conditions.

B. Uniformly mix ingredients as specified for each Mix Type (Base Component Material, leaf mold, and other ingredients deemed to be necessary as a result of testing) by wind rowing/tilling on an approved hard surface area. Organic matter shall be maintained moist, not wet, during mixing. Mixing of Amendments: Add leaf mold in proportions as specified and as confirmed by testing. Other amendments shall not be added unless approved to extent and quantity by Landscape Architect and Owner's Representative and additional tests have been conducted to verify type and quantity of amendment is acceptable.

C. Testing of Plant Mixes:

1. Perform initial tests to confirm compliance with base material and mix specifications. These test results, when approved, will establish the standard to which all other test results must conform.

2. Follow-up Testing: Have one (1) composite sample tested prior to delivery and upon arrival to the site from each 500 c.y. of material or as required by Owner's Representative intended for use in each type of lawn and plant mix to include the following

    a. Sieve Analysis: Use sieve sizes as specified for Base Component Material.

    b. Composition Analysis: Use the hydrometer method and classify the soil.

    c. Nutrient Analysis:

        1) Have nutrient levels (nitrate nitrogen, phosphate, potassium, magnesium, calcium, ammonium, iron, and manganese) tested, and request testing laboratory recommendations for additional fertilizer requirements at both lawn and all plant areas if nutrient levels are below average.

        2) Nutrient deficiencies in soils of plant areas shall be corrected at time of installation.

        3) Nutrient deficiencies in soils of lawn areas shall be corrected both at time of lawn installations and during maintenance period as specified.

    d. Test organic matter, pH, soluble salts, and percolation.

D. Soil Mix Types: Provide the following planting soil mix types at the locations indicated. Percentages of components, unless otherwise noted, will be established upon completion of individual test results for components of the various mixes. The controlling factor will be the percent (%) organic matter as specified for each mix. Note that percent (%) by volume of components will be, in large part, determined by the leaf mold. Specifically the bulk density reading of the leaf mold will directly impact the organic matter readings which have been specified for each mix.

    1. Planting Soil

        a. Organic Matter: 5.0 to 6.0%.

        b. Base Component Materials: 60-70%. (Exact percent to be identified through testing as previously specified)

        c. Leaf mold: 30-40%. (Exact percent to be identified through testing as previously specified)

        d. Other Amendments as required by test results and as approved.

E. Stockpiling

1. General: Stockpiling on-site, off-site and at source should be restricted to no more than the needs of what can be used in a 24-hr. period. Stockpiles should be no more than 6 feet in height to prevent anaerobic conditions within the pile(s). Stockpiles shall be sheltered from weather to prevent excessive water absorption and blowing by winds as approved by Owner's Representative.

2.4 SUPPLEMENTAL CHEMICAL COMPONENTS:

A. The following but not limited to chemical components may or may not be used depending on the outcome of the solids agricultural suitability test.

B. Dolomite Lime: Agricultural grade mineral soil conditioner containing 35% minimum magnesium carbonate and 49% minimum calcium carbonate, 100% passing #65 sieve. "Kaiser Dolomite 65 AG" as manufactured by Kaiser, Inc. Mineral Products Department, or equal.

C. Iron Sulfate (Ferric or Ferrous): Supplied by a commercial fertilizer supplier, containing 20% Fe as ferrous sulfate.

D. Single Superphosphate: Commercial product containing 20% to 25% available phosphoric acid.

E. Potassium Nitrate: Commercial product: 13-0-44.

F. Calcium Nitrate: Agricultural grade containing 15-1/2% nitrogen.

PART 3 - EXECUTION

3.1 VERIFICATIONS

A. Prior to construction and soil placement operations at planting areas, ascertain the location of all electric cables, conduits, underdrainage systems and utility lines.

B. Take proper precautions so as not to disturb or damage sub-surface elements. Contractor failing to take these precautions shall be responsible for making requisite repairs to damaged utilities at Contractor's own expense.

C. Verify that required underground utilities are available, in proper location, and ready for use. Coordinate with other trades.

D. Verify that all work requiring access through or adjacent to areas where plant mixes are to be placed has been completed and no further access will be required. In the event that access will be required, this must be coordinated with the Owner's Representative.

3.2 PREPARATION OF SUBGRADE

A. Prior to dumping and spreading sand and plant mix soils, the Contractor shall furnish and install grade stakes on a 10 foot grid in open areas and sufficiently spaced in other areas to insure correct line and grade of subgrade and finished grade.

1. Verify as constructed or existing subgrade elevations and do whatever additional grading is necessary to bring the subgrade to a true, smooth, slope parallel to the finish grade at all areas to receive planting soil for lawns.

2. Clean up subgrade and dispose of all debris and garbage prior to inspection.

B. Spray all vegetation on subgrade with a post emergent weed killer at a rate of application approved by the Landscape Architect and government agencies with jurisdiction.

C. Any soils polluted by gasoline, oil, plaster, construction debris, unacceptable soils, or other substances which would render-subgrade unsuitable for a proper lawn or plant growth shall be removed from the premises whether or not such pollution occurs or exists prior to or during the Contract period. In the event that such material is placed, this material shall be removed and replaced with approved material. All remedial operations associated with soil mixes and controlled fill shall be reviewed and approved by the Owner's Representative.

3.3 PLANTING MIXTURES

A. Planting Mixture for planters and plant backfill shall be of the type(s) indicated in accordance with the planting details, and shall be pre-mixed and placed as specified.

1. Bring to pH levels of 6.0 (+/- 0.5). pH-shall be verified by testing.

2. Lower pH by using elemental sulfur product. Peat moss or copper sulfate may not be used to lower pH.

B. All amendments shall be thoroughly incorporated into the mixture to assure uniform distribution. Delay mixing of fertilizers if planting will not follow within a few days.

3.4 PLACING PLANTING SOIL

A. Remove all large clods, lumps, brush, roots, stumps, litter, and other foreign material and stones one-half inch (1/2") in diameter or larger. Dispose of removed material legally off-site.

B. Do not place a muddy or wet soil mix.

C. Place and spread planting soil mix of the type specified over approved subgrade to a depth sufficiently greater than the depth required for planting areas so that after natural settlement, misting and/or light rolling, as previously approved by Landscape Architect and Owner's Representative, the completed work will conform to the lines, grades, and elevations shown or otherwise indicated.

D. Grading Tolerances: Lawn and Planting areas shall be fine graded within ±1/10 (0.10) feet of grades indicated on drawings. Maintain all “flat” areas and slopes to allow free flow of surface drainage without ponding.

END OF SECTION 32 91 00

SECTION 32 92 00

LAWNS AND GRASSES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Provide lawns and sod in accordance with the contract documents.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 32 9300 – Landscape Planting

2. Section 32 9100 - Soil Preparation and Mixes

3. Construction Documents

1.3 REFERENCES

A. Hortus III - 1976 Edition, Bailey Horatorium, Cornell University.

B. Technical Association of the Pulp and Paper Industry for Wood Cellulose.

C. Contract Drawings and Documents

1.4 EXAMINATION OF SITE AND DOCUMENTS

A. By submitting a bid the Contractor affirms that he has carefully examined the site and all conditions affecting work under this Section. No claim for additional costs will be allowed because of lack of full knowledge of existing conditions.

B. Plans, specifications, surveys, measurements, other documents and dimensions under which the work is to be performed are believed to be correct; but the Contractor shall have examined them for himself during the Bidding period, as no additional compensation will be made for errors for inaccuracies that may be found therein.

1.5 SUBMITTALS TO LANDSCAPE ARCHITECT

A. Product Data: Manufacturer's current catalog cuts and specifications of the following:

1. Fertilizer

2. Mulch

B. Certificates:

1. Certificates of inspection as required by law for transportation of each shipment of seed along with invoice.

2. Seed mix certificate including fertilizer and rate of application.

1.6 FIELD QUALITY CONTROL

A. Tests: Samples of materials may be taken and tested for conformity to Specifications at any time.

B. Rejected Materials: Remove rejected materials immediately from the site at contractor's expense. Pay cost of testing of materials not meeting Specifications.

1.7 DELIVERY, STORAGE AND HANDLING

A. Seed:

1. Delivery: Furnish standard seed in unopened manufacturer's standard containers bearing quantity, analysis and name of manufacturer

2. Storage: Store seed with protection from weather, rodents or other conditions, which would damage or impair the effectiveness of the product.

B. Mulch:

1. Labeling: Each package of the cellulose fiber shall be marked by the manufacturer to show the air dry weight content.

2. Storage: Store seed with protection from weather, rodents or other conditions, which would damage or impair the effectiveness of the product.

1.8 PROJECT/SITE CONDITIONS

A. Existing Conditions: For protection of existing plants to remain, refer to Spec Section 32 93 00 – Landscape Planting

1.9 SEQUENCING AND SCHEDULING

A. Period of Application of Hydroseeding:

1. Irrigated Areas: Within fourteen (14) calendar days after the completion of finish grading in any area.

B. Scheduling:

1. Hydroseeding: Perform on a section-by-section basis, upon approval of Landscape Architect, and immediately after finish grading and irrigation installation except for seasonal Limitations.

a. Season: Plant in Fall or Spring.

1) Allow sufficient time for full germination and 2 mowings before preliminary acceptance.

2. Embankment and Slopes: Complete in a continuous manner.

3. Acceptable Planting Window:

a. Place grass seed or sod only at seasonal times within appropriate temperature range and wind conditions for plant development as approved by Landscape Architect:

b. Acceptable Seeding Seasons/Times:

1) Spring: April 1st - June 15th

2) Fall: September 1st - October 15th

c. Seeding or sodding at any time other than within the above seasons shall be allowed only when the Contractor submits a written request for permission to do so and permission is granted in writing by the Owner. Newly seeded or sodded areas, if installed out of season, must be continuously watered according to best recommended and Landscape Architect approved practice. Contractor shall be responsible for providing an acceptable stand of grass as specified.

1.10 WARRANTY

A. The 90 day maintenance period begins with the Landscape Architects certification of substantial completion. The warranty period begins after the final acceptance of the maintenance period. The final acceptance occurs upon satisfactory completion of all work, included in the 90 day maintenance period, but exclusive of replacement of materials under the Warranty Period.

B. Time Period: Warrant that lawns and meadows shall be in a healthy and flourishing condition of active growth one (1) year from date.

C. Appearance During Warranty: Lawns and sod shall be free of dead or dying patches, and all areas shall show foliage of a normal density, size and color.

D. Delays: Delays caused by the Contractor in completing planting operations, which extend the planting into more than one planting season, shall extend the Warranty Period correspondingly.

E. Coverage: Warrant growth and coverage of hydroseeded planting to the effect that a minimum of 95% shall be covered with specified planting after one growing season with no bare spots.

F. Exceptions: Contractor shall not be held responsible for failures due to neglect by owner, vandalism, etc., during Warranty Period. Report such conditions in writing.

PART 2 -PRODUCTS

2.1 MANUFACTURERS/GROWERS

A. Hydro Mulch and Soil Stabilizer: Obtain mulch and soil stabilizer from a certified source within proximity of the project site.

B. Fertilizer:

1. Regular Type: Nitrogen content derived from organic sources; bearing manufacturer's statement of analysis. Minimum requirements: 12% nitrogen, 4% phosphoric acid, 8% potash.

2. Slow-release Type: 50% of nitrogen is in slow-release form. Content derived from organic or inorganic sources; bearing manufacturer's statement of analysis. Minimum requirements: 12% nitrogen, 4% phosphoric acid, 8% potash.

3. Commercial Mixed Type: Nitrogen content derived from organic or inorganic sources, bearing manufacturer's statement of analysis. Minimum requirements: 10% nitrogen, 10% phosphoric acid, 10% potash.

C. Lime: Ground limestone containing not less than 85% carbonates; 50% passing 100 mesh sieve and 90% passing 20 mesh sieve.

D. Seed: Shall be of a mix as specified on the plans furnished in un-opened containers and providing percentage of seed varieties and inert matter. All non-turf seeds shall be purchased and applied at a Pure Live Seed (PLS) rate as indicated on the plans. This may require the contractor to purchase/apply seed at a high rate as measured by bulk weight.

E. Straw Bales: Clean bales of straw of hay, wheat, rye, oats or barley.

F. Hydromulch: Wood cellulose fiber containing no germination inhibiting or growth inhibiting agents. Characteristics shall be as follows:

1. Percent moisture content: 9.0% (+3.0%)

2. Percent organic matter: 99.2% (+0.8).

3. Percent ash content: 0.8% (+0.2%).

4. pH: 4.8 (+0.5).

5. Water Holding Capacity: 1150 grams water/100 grams fiber, minimum.

G. Mulch: Clean, seed free straw of hay, wheat, rye, oats or barley.

H. Staking Pegs: 3/4" diameter by 8" long softwood.

I. Water: Clean, potable.

2.2 ACCESSORIES

A. Mulch: Shall be Product: "Silva Fiber", "X-100 Spra-mulch", or "Conwed".

1. Composition: Green-colored, fibrous, 100% virgin wood fibre mulch containing no growth or germination-inhibiting factors.

2. Weight: Weight specifications of this material from suppliers, and for all applications, shall refer only to air dry weight of the fiber material. Absolute air dry weight is based on the normal standards for wood cellulose and is considered equivalent to 10% moisture.

3. Dispersion in Slurry: Mulch shall be manufactured in such manner that after addition to and agitation in slurry tanks with fertilizer, seed, water and other approved additives, fibers in the material will become uniformly suspended to form a homogeneous slurry.

4. Absorption Capacity: When hydraulically sprayed on the ground, the material will form a blotter-like groundcover impregnated uniformly with seed, which will allow absorption of moisture and allow rainfall to percolate to the underlying soil.

2.3 HYDROSEED EQUIPMENT (if required)

A. Type: Commercial type hydro-seeder for the application of slurry. Equipment shall have a built-in agitation system with an operating capacity sufficient to agitate, suspend and homogeneously mix slurry.

B. Distribution Lines: Large enough to prevent stoppage and to provide even distribution of the slurry over the ground.

C. Pump Capacity: 150 psi at the nozzle.

D. Slurry-Tank: Minimum capacity of 1,000 gallons and shall be mounted on a traveling unit which will place the slurry tank and spray nozzles within sufficient proximity to the areas to be seeded.

2.4 MIXES

A. Hydroseeding Mix per (1,000 Sq. Ft.)

1. Lawn Areas:

a. 30 lbs. - Mulch

b. 7 lbs. - Lawn Seed

c. 10 lbs. - Fertilizer

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Stones, Weeds, Debris: Verify that all areas to receive hydroseeding are clear of stones larger than 1/2 in. diameter, weeds, debris and other extraneous materials.

2. Grades: Verify that grades are within 1 in. plus or minus of the required finished grades. Verify that fertilization have been installed in another section. Report all variations in writing.

3.2 PREPARATION

A. Soil Moisture:

1. Excessive Moisture: Do not commence work of this section when soil moisture content is so great that excessive compaction will occur, nor when it is so dry that dust will form in air or that clods will not break readily.

2. Inadequate Moisture: Apply water, as necessary, to bring soil moisture content to an acceptable level.

3.3 HYDROSEEDED LAWN

A. Preparation: Do all slurry preparation at the job site.

1. Water: Add water to the tank when the engine is at half throttle. When the water level has reached the height of the agitator shaft, establish good re-circulation and add seed.

2. Seed: Do not allow seed to remain more than 30 min. in slurry.

3. Fertilizer: Add fertilizer, followed by the mulch. The mulch shall only be added to the mixture after the seed, and when the tank is at least 1/3 filled with water.

4. Mixing: Open the engine throttle to full speed when the tank is half-filled with water. Add all the mulch by the time the tank is 2/3 to 3/4 full. Commence spraying immediately when the tank is full.

B. Seed Bed Preparation:

1. Rolling: Roll amended soil with 200 pound water ballast roller and bring to finish grade.

2. Raking: Lightly rake seed bed surface to 1/4 in. depth. Seed immediately thereafter, provided the seed bed has remained in friable condition. Application:

3. General: Apply specified slurry mix in a sweeping motion to form a uniform mat at the specified rate. Keep hydroseeding within designated areas and keep from contact with other plant materials.

4. Unused Mix: Do not use a slurry mixture, which has not been applied within 4 hours of mixing. Promptly remove from the site.

5. Protection: After application, do not operate any equipment over the hydroseeded areas.

6. Reseeding: Reseed all areas and parts of areas, which fail to show a uniform stand of lawn until all areas are covered with strands of lawn.

3.4 CLEANING

A. Hydroseed Overspray: Immediately after application, thoroughly wash off any plant materials, planting areas, or paved areas not intended to receive slurry mix.

B. Erosion: Immediately restore eroded areas. Keep all adjacent paved surfaces cleaned of dirt, mud or stains and organic debris.

END OF SECTION 32 92 00

SECTION 32 93 00

LANDSCAPE PLANTING

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. The Contractor shall furnish all materials and perform all work in accordance with these specifications, drawings, and instructions provided by the Owner's representative hereafter also referred to as Landscape Architect.

B. The work shall include everything shown on the drawings and required by the specifications and everything to which in the judgment of the Landscape Architect is incidental to what is shown on the drawings or required by the specifications.

C. RELATED DOCUMENTS

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

2. Construction Documents and Drawings

3. Section 31 2000 - Earthwork

4. Section 32 9100 – Soil Preparation and Mixes

5. Section 32 9300 – Lawns & Grasses

1.3 REFERENCES

A. Plant material shall in all cases conform with requirements of the American Standard for Nursery Stock latest versions of rules and grading adopted by the American Association of Nurserymen, Inc., but upgraded to meet the following additional requirements.

1.4 QUALITY ASSURANCE

A. All work completed and materials furnished and installed shall be of the best quality and shall be in strict accordance with the intention of the drawings, specifications and samples. The Contractor shall cooperate with the Landscape Architect so that no error or discrepancy in the drawings or specifications shall cause defective or inappropriate materials to be used or poor workmanship to be allowed and so that the work may proceed in the most efficient and effective manner.

If there is a discrepancy between the graphic count of plants and the plant list count of plants on the Landscape Plan, the graphic count shall govern.

B. Work must be carried out only during weather conditions favorable to landscape construction and to the health and welfare of plants. The suitability of such weather conditions shall be determined by the Landscape Architect.

C. Before commencing work, all trees and shrubs which are to be saved must be protected from damage by the placement of fencing flagged for visibility or some other suitable protective procedure consistent w/ tree protection measures on the plans and approved by the Owner's Construction Manager. No work may begin until this requirement is fulfilled.

D. In order to avoid damage to roots, bark or lower branches, no truck or other equipment shall be driven or parked within the drip line of any tree, unless the tree overspreads a paved way.

E. The contractor shall use any and all precautionary measures when performing work around trees, walks, pavements, utilities, and any other features either existing or previously installed under this Contract.

F. The Contractor shall adjust depth of earthwork and topsoiling when working immediately adjacent to any of the aforementioned features in order to prevent disturbing tree roots, undermining walks and pavements, and damage in general to any existing or newly incorporated item.

G. Plants transported to the project in open vehicles shall be covered with tarpaulins or other suitable covers securely fastened to the body of the vehicle to prevent injury to the plants. Closed vehicles shall be adequately ventilated to prevent overheating of the plants. Evidence of inadequate protection following digging, carelessness while in transit, or improper handling or storage shall be cause for rejection. All plants shall be kept moist, fresh, and protected. Such protection shall encompass the entire period during which the plants are in transit, being handled, or are in temporary storage.

H. Where excavating, fill, or grading is required within the branch spread of trees that are to remain, the work shall be performed as follows:

1. Trenching: When trenching occurs around trees to remain, the tree roots shall not be cut but the trench shall be tunneled under or around the roots by careful hand digging and without injury to the roots.

2. Raising grades: When the existing grade at tree is below the new finished grade, and fill not exceeding 16 inches (16") is required, clean, washed gravel graded from one to two inches (1" - 2") in size shall be placed directly around the tree trunk. The gravel shall extend out from trunk on all sides a minimum of 18 inches (18") and finish approximately two inches (2") above the finished grade at tree. Install gravel before any earth fill is placed. New earth fill shall not be left in contact with the trunks of any trees requiring fill. Where fill exceeding 16 inches (16") is required, a dry laid tree well shall be constructed around the trunk of any tree to be preserved. The tree well shall extend out from the trunk on all sides a minimum of three feet (3') and to three inches (3") above finish grade or as indicated in the drawings. Coarse grade rock shall be placed directly around the tree well extending out to the drip line of the tree. Clean, washed gravel graded from one to two

inches (1" - 2") in size shall be placed directly over the coarse rock to a depth of three inches (3"). Approved backfill/topsoil material shall be placed directly over the washed gravel to desired finished grade.

3. Lowering grades: Existing trees in areas where the new finished grade is to be lowered shall have regrading work done by hand to elevation as indicated. Roots as required shall be cut cleanly three inches (3") below finished grade.

4. Trees marked for preservation that are located more than six inches (6") above proposed grades shall stand on broad, rounded mounds and be graded smoothly into the lower level. Trees located more than 16 inches (16") above proposed grades shall have a dry laid stone wall, or other retaining structure as detailed on the plans, constructed a minimum of five feet (5') from the trunk. Exposed or broken roots shall be cut clean and covered with topsoil immediately to prevent desiccation.

I. The Landscape Architect reserves the right to inspect and reject plants at any time and at any place, and reserves the right to inspect plants at the growing nursery.

J. The Landscape Architect shall have the final approval for acceptance of the landscape planting work.

1.5 SAMPLES

A. It is the responsibility of the Contractor, before ordering or purchasing materials, to provide samples of those materials to the Landscape Architect for approval, if so requested.

B. The Contractor is to submit certification tags from trees, shrubs and miscellaneous materials verifying type, quality and purity.

1.6 QUALITY OF PLANTS

A. Plants shall in all cases conform with requirements of the American Standard for Nursery Stock latest versions of rules and grading adopted by the American Association of Nurserymen, Inc., but upgraded to meet the following additional requirements.

B. Unless specifically noted otherwise, all plants shall be of selected specimen quality, exceptionally heavy, symmetrical, tightly knit, so trained or favored in their development and appearance as to be superior in form, number of branches, compactness and symmetry. All plants shall have a normal habit or sound, healthy, vigorous plants with well-developed root system.

C. Plants shall be free of disease, insect pests, eggs or larvae.

D. Plants shall not be pruned before delivery.

E. Trees with abrasion of the bark, sunscalds, disfiguring knots or fresh cuts of limbs over one and one-fourth inches (1-1/4") which have not completely calloused shall be rejected.

F. All plants shall be typical of their species or variety and shall have a normal habit of growth and be legibly tagged with the proper name. All plants shall have been grown under climatic conditions similar to those in the locality of the site of the project under construction or have been acclimated to such condition for at least two (2) years.

G. The root system of each shall be well provided with fibrous roots. All parts shall be sound, healthy, vigorous, and well-branched.

H. All plants designated ball and burlap (B&B) must be moved with the root systems as solid units with balls of earth firmly wrapped with burlap. The diameter and depth of the balls of earth must be sufficient to encompass the fibrous root feeding systems necessary for the healthy development of the plant. No plant shall be accepted when the ball of earth surrounding its roots has been badly cracked or broken preparatory to or during the process of planting. The balls shall remain intact during all operations. All plants that cannot be planted at once must be heeled-in by setting in the ground and covering the balls with soil or mulch and then watering. Hemp burlap and twine is preferable to treated. If treated burlap or twine is used, all twine is to be cut from around trunk and all burlap is to be removed.

I. The trunk of each tree specified as ‘tree form’ shall be a single trunk growing from a single unmutilated crown of roots. No part of the trunk shall be conspicuously crooked as compared with normal trees of the same variety.

J. The thickness of each shrub shall correspond to the trade classification "No.1". Single stemmed or thin plants shall not be accepted. The side branches must be generous, well twigged, and the plant as a whole well branched to the ground. The plants must be in healthy condition, free from dead wood, bruises or other root or branch injuries.

K. Plants shall be measured when branches are in their normal position.

L. Shrubs shall meet the requirements for spread, height or container size stated in the Plant List. The measurements are to be taken from the ground level to the average height of the shrub and not to the longest branch. Height and spread dimensions specified refer to the main body of the trees (measured from the crown of the roots to the tip of the top branch) shall be not less than the minimum size designated.

M. Caliper measurements shall be taken at a point on the trunk six inches (6") above natural ground line for trees up to four inches (4") in caliper, and at a point 12 inches (12") above the natural ground line for trees exceeding four inches (4") in caliper.

N. If a range of size is given, no plant shall be less than the minimum size, and not less than 50% of the plants shall be as large as the upper half of the range specified.

O. The measurements specified are the minimum size acceptable and, where pruning is required, are the measurements after pruning.

1.7 MAINTENANCE OPERATIONS BEFORE APPROVAL

A. Plant care shall begin immediately after each plant is satisfactorily installed and shall continue throughout the life of the contract until final acceptance of the project.

B. Care shall include, but not be limited to, replacing mulch that has been displaced by erosion or other means, repairing and reshaping water rings or saucers, maintaining stakes and guys as originally installed, watering when needed or directed, and performing any other work required to keep the plants in a healthy condition.

C. Contractor shall remove and replace all dead, defective and/or rejected plants as required before final acceptance.

1.8 NOTIFICATION OF DELIVERY

A. Unless otherwise authorized by the Landscape Architect, the Contractor shall notify the Landscape Architect at least 48 hours in advance of the anticipated delivery date of any plant materials. A legible copy of the invoice, showing kinds and sizes of materials included for each shipment shall be furnished to the Landscape Architect.

1.9 GUARANTEE

A. The condition of all new plant materials is the responsibility of the Contractor and shall be approved by the Landscape Architect.

B. Until final approval, any replacement of plant materials that may be necessary shall be at the expense of the Contractor.

C. In addition to other standard provisions, the Contractor's bid amount shall also provide for the following:

1. Maintenance necessary during Establishment Period including provision of supplemental irrigation, through final acceptance.

2. Replacement in kind, or with a substitute acceptable to the Landscape Architect, of all plant materials not in a healthy growing condition or that has died back to the crown or beyond normal pruning limits.

3. The Contractor shall also be responsible for any damage caused by his operations and shall dispose of all rubbish and excess soil as directed.

PART 2 - MATERIALS

2.1 TOPSOIL

A. Work included – Topsoil incidental to landscape planting operations shall be as described in Section 329100 Soil Preparation and Mixes.

2.2 SHREDDED HARDWOOD BARK MULCH

A. Shredded hardwood bark mulch or approved equal shall be used as a four inch (4") top dressing in all plant beds and around all trees planted by landscape contractor. Single trees or shrubs shall be mulched to the outside edge of the saucer. Mulch shall be of sufficient character as not to be easily displaced by wind or water runoff.

2.3 STAKING MATERIALS

A. Plant materials which satisfy the requirements of this specification should not require staking, however contractor shall install stakes if requested by the Landscape Architect or Owner.

B. Stakes shall be 2" x 2" x 8' white oak pressure treated for stakes. Three (3) stakes per tree.

C. Guy wire for tree staking shall be pliable No. 12 galvanized soft steel wire.

D. Hose shall be two-ply fiber-bearing rubber garden hose, not less than one-half inch (½") inside diameter, black or green, and of suitable length.

2.4 WATER

A. On-site water shall be furnished by the Contractor. Hose and other watering equipment shall be furnished by the Contractor.

2.5 ANTI-DESICCANT SPRAY

A. Spray shall be an emulsion which will provide a protection fill over plant surfaces. It shall be permeable enough to permit transpiration such as "Wilt-Pruf", manufactured by Nursery Product Specialties Company, Croton Falls, New York, or other approved equal. It shall be delivered in the manufacturer's containers and mixed according to the manufacturer's instructions.

PART 3 - EXECUTION

3.1 PLANTING COORDINATION

A. The Contractor shall inform the Landscape Architect of the date when the planting shall commence and of the anticipated delivery date of the material.

B. Failure to notify the Landscape Architect in advance of order to arrange proper scheduling may result in loss of time or rejection of a plant or plants not installed as specified or directed.

3.2 DIGGING AND HANDLING

A. Bare rooted shrubs shall be dug with adequate fibrous roots. Roots of these plants shall be covered with a uniformly thick coating of mud by being puddled immediately after they are dug, or packed in moist straw, or moss.

B. Balled and burlapped plants shall be dug with firm natural balls of earth of sufficient diameter and depth to include most of the fibrous roots.

C. Roots or balls of all plants shall be adequately protected at all times from the sun and from drying winds.

D. All balled and burlapped plants which cannot be planted immediately upon delivery shall be set on the ground in a shady location and shall be well protected with soil, wet mulch or other ac-

ceptable material. Plant material shall be kept moist with periodic watering with fresh clean water. Bare rooted plants, which cannot be planted immediately, shall be heeled-in upon delivery. All shall be kept moist. At no time shall plants be staged in direct sun or on asphalt surfaces.

E. Bundles of plants shall be opened and the plants separated before the roots are covered. Care shall be taken to prevent air pockets among the roots. During planting operations, bare roots shall be covered with canvas, hay or other suitable material. No plant shall be bound with wire or rope at any time so as to damage the bark or break the branches.

3.3 TREES AND SHRUB PLANTING OPERATIONS

A. Planting operations shall be performed at a steady rate of work unless weather conditions make it impossible to work. No plant material shall be planted in frozen ground.

B. The Contractor shall provide sufficient tools and equipment required to carry out the planting operation.

C. All plants too large for two men to lift in and out of holes shall be placed with a sling. Do not rock trees in holes to raise ball elevation.

D. For soil mix for plant holes, see Materials - 2.01 Topsoil.

E. If rock or other underground obstruction is encountered, the Landscape Architect may require plant pits to be relocated, the pits enlarged or the plants deleted from the contract.

F. Locations containing unsuitable subsoil shall be treated in one of the following manners:

1. Where unsuitability within the construction site is deemed by the Landscape Architect to be due to excessive compaction caused by heavy equipment or by the presence of boards, mortar, concrete or other construction materials in sub-grade, and where the natural subsoil is other than A.A.S.T.H.O. classification of A6 or 7, the Contractor shall loosen such areas with spikes, discing, or other means to loosen the soil to a condition acceptable by the Landscape Architect. The Contractor shall also remove all debris and objectional material. Soil should be loosened to a minimal depth of 12 inches (12") with additional loosening as required to obtain adequate drainage. Contractor may introduce sand or organic matter into the subsoil to obtain adequate drainage as directed by the Landscape Architect. All such remedial measures shall be considered as incidental to the work and no extra payment shall be made for this part of the work.

2. Where sub-grade is deemed by the Landscape Architect/ Engineer to be unsuitable because the natural subsoil falls into an A.A.S.T.H.O. classification of A6 or 7 and contains moisture in excess of 30%, then such a condition shall be rendered suitable by installation of a sub-drainage system or by other means described elsewhere in these specifications. Where such conditions have not been known or revealed prior to planting time and where they have not been recognized in the preparation of plans and specifications, then the Landscape Architect shall issue a change order to install the proper remedial measures, all of which shall be in addition to the contract sum.

G. Adjustments in locations of planting beds and bed outlines shall be made as directed. In the event that pits or areas for planting are prepared and backfilled with topsoil to grade prior to commencement of lawn operations, they shall be so marked that when the work of planting proceeds, they can be readily located. In case underground obstructions such as ledges or utilities are encountered, location shall be changed under the direction of the Landscape Architect without charge, to the owner.

H. Holes for trees shall be at least two and one-half times (2.5x) greater in diameter than the diameter of the root ball and of a depth that allows the tree to sit at the same elevation as grows in the nursery. Holes for shrubs and vines shall be at least 12 inches (12") greater in diameter than the spread of the root system and of a depth that allows the shrub and vines to sit at the same elevation as grown in the nursery.

I. To the topsoil in the backfilling of tree holes and shrub beds, there shall be added as the progress of the work permits, ground limestone if soil tests indicate it is needed and with prior approval by landscape architect, and commercial fertilizer at the rate of three (3) pounds for tree up to three inches (3") in caliper, one (1) pound per one inch (1") in caliper for larger trees, six (6) ounces for small shrubs and eight (8) ounces for each shrub four feet (4') or over. Ground limestone shall be omitted in the case of acid soil plants. The limestone and fertilizer shall be thoroughly mixed with the topsoil in the planting operation.

J. The plants shall be planted in the center of the holes and at the same depth as they previously grew. Topsoil shall be backfilled in layers of not more than eight inches (8") and each layer watered sufficiently to settle before the next layer is put in place. Topsoil shall be tamped under edges of balled plants. Enough topsoil shall be used to bring the surfaces to finish grade when settled.

1. A saucer shall be provided around each plant as shown on the drawings.

2. Plants shall be soaked with water twice within the first twenty-four (24) hours of time of planting. Water shall be applied with low pressure so as to soak in thoroughly without dislodging the topsoil.

3. A three-inch (3") layer (after settlement) of mulch or approved equal shall be applied directly on to the entire area of each saucer or planting bed.

3.4 MAINTENANCE DURING CONSTRUCTION

A. Maintenance shall begin immediately after planting. Plants shall be watered, mulched, weeded, pruned, sprayed, fertilized, cultivated, and otherwise maintained and protected until provisional acceptance. Settled plants shall be reset to proper grade and position, planting saucer restored and dead material removed. Stakes and wires shall be tightened and repaired. Defective work shall be corrected as soon as possible after it becomes apparent and weather and season permit.

B. If a substantial number of plants are sickly or dead at the time of inspection, acceptance shall not be granted and the Contractor's responsibility for maintenance of all plants shall be extended until replacements are made or existing plants are deemed acceptable by the Landscape Architect.

C. All replacements shall be plants of the same kind and size specified on the Plant List. They shall be furnished and planted as specified above. The cost shall be borne by the Contractor. Replacements resulting from removal, loss, or damage due to occupancy of the project in any part, vandalism, physical damage by animals, vehicles, etc., and losses due to curtailment of water by local authorities shall be approved and paid for by the Owner.

D. Plants shall be guaranteed for a period of one (1) year after inspection and provisional acceptance.

E. At the end of the Establishment Period, inspection shall be made again. Any plant required under this contract that is dead or unsatisfactory to the Landscape Architect or Owner shall be removed from the site. These shall be replaced during the normal planting season.

PART 4 - MAINTENANCE CONTRACT

4.1 GENERAL LANDSCAPING

A. Contractor shall provide the Owner with a written proposal due no later than the established possession date for landscape maintenance from an experienced local A.A.N. certified nursery business capable of performing the work outlined herein. The proposal shall be for a period of 1 year and be renewable in one-year increments. Maintenance will begin immediately after completion of substantial completion, the maintenance contract work shall not void the guarantee of the plant material for the first year after acceptance by the Owner. Replacement of dead plant material shall be covered under the warrantee of the original installation, final approval and acceptance of the landscaping and irrigation by the Owner.

B. Landscape maintenance shall include all necessary watering, cultivation, weeding, pruning, wound dressing, disease and insect pest control, protective spraying, straightening plants which lean or sag, adjustments of plants which settle or are planted too low, mowing of turf areas, replacement of mulch that has been displaced by erosion or other means, repairing and reshaping of water rings or saucers, re-placement of mulch that has been displaced by erosion or subsidence, and the reseeding or replanting of those areas affected. Removal of all rubbish, waste, tools, and equipment used in the execution of the contract at the end of each work day, and any other procedure consistent with good horticultural practice necessary to insure normal, vigorous and healthy growth of all plant material are also part of this maintenance contract.

C. During the first year of the maintenance contract, any replacement of plant material shall be the responsibility of the installing contractor.

D. Landscape maintenance contractor shall purchase and maintain Contractor's general liability insurance in the amounts of $10,000 to protect him from the Contractor's operations under the maintenance contract. Certification of such insurance shall be filed with the Owner prior to the commencement of the work.

4.2 WATERING

A. The irrigation system, if installed on the site, shall be used by the maintenance contractor for the watering program, but any failure of the system does not eliminate the Contractor's responsibility of maintaining the desired level of moisture necessary to maintain vigorous, healthy growth.

B. The quality of water applied at one time shall be sufficient to penetrate the soil to a minimum of eight inches (8") in shrub beds and six inches (6") in turf areas at a rate, which will prevent saturation of the soil.

C. On-site water shall be furnished by the Owner. Hose, portable tanks, pumps, nozzles or any other watering equipment required to transport water from available locations and apply it by approved methods shall be furnished by the Contractor.

4.3 WEEDING

A. Maintenance contractor shall keep all planting areas free from weeds and undesirable grasses by a method and by materials approved by the A.N.A.

4.4 DISEASE AND INSECT PEST CONTROL

A. Inspect all plant material at least once a month to locate any disease or insect pest infestations. Upon the discovery of any disease or insect pest infestation, identify, or have identified, the nature or species of the infestation. A method of control in accordance with common A.N.A. standards shall be immediately implemented.

4.5 FERTILIZING

A. Maintenance contractor is to fertilize plant material on a regularly scheduled program to fit the requirements of the plant material to maintain vigorous and healthy plant growth.

4.6 PRUNING AND REPAIR

A. The amount of pruning shall be limited to the minimum necessary to remove dead or injured twigs and branches or to maintain safety in vehicular use areas. Pruning shall be done in such a manner as to not change the natural habit or shape of the plant. All cuts shall be made flush, leaving no stubs.

4.7 MOWING

A. Refer to plans for individual seed mix mowing notes.

4.8 CLEAN UP

A. During the course of maintenance planting, excess and waste materials shall be continuously and promptly removed at the end of each work day.

4.9 MAINTENANCE REPORT AND SCHEDULE OF ACTIVITIES

A. Maintenance contractor shall provide a schedule and report to store management and to the address referenced in this section, 4.01, A. that details his planned maintenance activities including any subcontractors.

4.10 MAINTENANCE CONTRACT

A. These terms and conditions herein outlined shall be attached and made a part of a maintenance contract with the Owner.

4.11 TERMINATION OF THE MAINTENANCE CONTRACT

A. If the Owner fails to make payment for a period of ninety (90) days without written clarification, the maintenance contractor may, upon twelve (12) additional days' written notice to the Owner, terminate the contract and recover from the Owner, payment for all work executed and for any proven loss sustained upon any materials, equipment, or tools, including reasonable profit and damages applicable to the maintenance contract.

B. If the maintenance contractor defaults or persistently fails or neglects to carry out the work in accordance with the maintenance contract, the Owner, after twelve (12) days' written notice to the maintenance contractor, and without prejudice to any other remedy they may have, may make good such deficiencies and deduct the cost thereof, including compensation for additional services made necessary thereby, from the payment then or thereafter due the contractor, or at their option, may terminate the contract.

END OF SECTION 32 93 00

SECTION 32 93 03

TREE REMOVAL AND SELECTIVE THINNING

PART 1 GENERAL (Not Used)

PART 2 PRODUCTS

2.01 MATERIALS

A. Tree Pruning Compound: Waterproof, antiseptic, elastic and free of kerosene, coal tar, creosote, and other substances harmful to plants.

PART 3 EXECUTION

3.01 PREPARATION

A. Protection

1. Prevent damage to buildings, pavement, pipes, conduits, poles and other structures above and below ground that are adjoining or included in the contract area. Repair damage resulting from the contractor's negligence.
2. Protect existing trees and shrubs not to be removed. Cut back to point of branching all broken branches and skinned areas. Treat exposed wood with tree pruning compound of ten trees to be trimmed inside facility.
3. Store materials and equipment in cleared areas away from tree roots. Prevent employees and equipment from trampling over woodland, existing planting, and established lawns.

3.02 REMOVALS – TREES ENTIRELY

A. Remove trees where indicated.

B. Top and limb all trees before falling, unless otherwise approved by the Owner's Representative.

C. Grub out stumps to a depth of not less than 18 inches below exposed subgrade. Backfill stump holes with satisfactory soil material unless further excavation or earthwork is indicated.

3.04 PRUNING

A. Prune trees where indicated of undesirable wood with the resulting crown shaped to the natural habit of the tree, to a minimum of 20 feet clear from buildings. Remove all diseased and dead branches, and branches interfering with building exteriors. Scar trace bark wounds as directed. All cuts shall be cleanly made with sharp tools, flush with the parent trunk or limb. Paint cuts over 3 inches in diameter with tree pruning compound.

3.05 CLEAN UP – TREES TRIMMED AND REMOVED

A. Remove and dispose of all logs, tree trimmings, and debris from County property. Leave Work area in a neat uncluttered condition, where indicated or specified.

END OF SECTION 32 93 03

SECTION 33 11 01 - WATER UTILITY DISTRIBUTION PIPING

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. This Section includes water distribution piping and fittings.

B. Related Sections include the following:
1. Section 31 00 00 – Earthwork
2. Section 33 11 26 – Water Utility Distribution Valves.

1.3 REFERENCES

A. Recommended Standards for Water Works (Ten State Standards) latest Edition.

B. "Report, Geotechnical Investigation, Proposed Animal Shelter, Pomona, Rockland County, New York", prepared by Melick-Tully & Associates, dated September 14, 2021.

1.4 SUBMITTALS

A. Product Data: For the following:
1. Piping specialties.

B. Field Quality-Control Test Reports: From Contractor. Identify the following:
1. System Test: Conducted section-by-section or as an entire system.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Comply with requirements of utility company supplying water.
2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.
4. Comply with the requirements of the American Water Works Association, AWWA.
   a. C104 – Cement-Mortar Lining for Ductile Iron Pipe and Fittings.
   b. C151 – Ductile Iron Pipe.
   c. C600 – Installation of Ductile Iron Water Mains and Their Appurtenances
   d. C605 – Underground Installation of Polyvinyl Chloride (PVC)
   e. C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fitting

5. Comply with Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, "Recommended Standards for Water Works", latest edition.
6. Comply with Occupational Safety and Health Administration, OSHA, Standards 29 CFR, Section 1926, Subpart P and its latest revision.
7. Water and Sewer/Stormwater Line Separations:
    a. Horizontal Separation from Water Mains: 10 feet minimum clear.
    b. Vertical Separation from Water Mains: 18 inches minimum clear.
        1) If existing conditions prevent minimum vertical separation:
            a) Construct sewer of PVC pressure pipe material 10 feet on each side of the water main/sewer crossing. The sewer is to be pressure tested.
            b) Encase sewer pipe in concrete, 4 feet on each side of the water main/sewer crossing. Concrete encasement shall be a minimum of 6 inches around the sewer pipe.
    c. Where a water main crosses under a sewer, provide adequate structural support for sewer to maintain line and grade.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency. Defective pipe or fittings found after installation shall be removed and replaced by the Contractor at his own expense.

C. Disinfection of water mains and appurtenances: AWWA C651, excluding Section 5.1 covering the tablet method.

D. Inspection of pipes and appurtenances prior to backfilling.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane of lift. Rig valves to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points. Unload materials so as to avoid shock or damage. Handle and store all pipe in such a manner as to avoid deterioration or other injury thereto. Place no pipe within pipe of a larger size. Store pipe and fittings on sills above storm drainage level and delivery for laying after the trenches are excavated. Valves and hydrants shall be drained and stored to protect them from damage.

B. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

C. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

D. Protect flanges, fittings, and specialties from moisture, dirt, and falling debris.

E. Store plastic piping protected from direct sunlight. Support pipe to prevent sagging and bending.

F. Do not store or place materials on private property without written approval from the property owner.

1.7 PROJECT CONDITIONS

A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.

B. Locate existing structures and piping to be closed and abandoned.

C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
1. Notify Civil Engineer not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner's and Civil Engineer's written permission.

1.8 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 DUCTILE IRON PIPE

A. Kind
1. Ductile iron pipe shall be centrifugally cast Ductile Iron Pipe, 60-42-10 grade, cement lined in accordance with ANSI Specification A21.5. All Ductile Iron Pipe shall be Class 54 unless otherwise indicated.

B. Brand
1. The weight, class or nominal thickness and casting period shall be shown on each pipe. The manufacturer's mark, the year of manufacture and the letters "DI" or "DUCTILE" shall be cast or stamped. All markings shall be clear and legible and cast on or painted on or near the bell with an approved durable paint which will withstand field handling. Markings shall be in accordance with ANSI Specification A 21.51-71, latest revision.

C. Material
1. Pipe shall be centrifugally cast Ductile Iron Pipe, 60-42-10 grade, cement lined in accordance with ANSI Specification A21.5. Laying lengths shall not exceed twenty (20) feet.
2. All inside surfaces of ductile iron pipes shall be cement lined in accordance with ANSI specification A21.4. All outside surfaces of ductile iron pipe shall be shop coated with an approved bituminous enamel, applied hot in conformity with AWWA specification 203.

D. Joints
1. Unless otherwise specified, all joints for Ductile Iron Pipe shall be Push-On Joints.

2. The following type joints shall be used as specified:
   a. PUSH-ON JOINTS - Push-on joints shall be the Super Bell-Tite Joint of Amstead Industries, the Tyton Joint of U.S. Pipe and Foundry Company, the Fastite Joint of the American Cast Iron Company or such other joint as may be approved as equal by Suez Water New York. For each bell, there shall be furnished a rubber gasket. All of the above shall conform with the applicable provisions of ANSI Specification A21.11.
   b. MECHANICAL JOINTS - The joint material shall conform to requirements of ANSI Specification A21.11. The mechanical joint installation shall conform to the latest ANSI Specifications. Surface of joint in contact with rubber gasket seal shall be brushed thoroughly with a wire brush just prior to assembly and all loose rust or foreign material shall be removed. The cleaned surface shall be brushed with soapy water just prior to slipping with torque indicating wrenches. The applied torque shall be within the ranges shown below:

SIZE OF BOLT	TORQUE (Foot-Pounds)
5/8"	40-60
3/4"	50-90
1"	70-100

3. When tightening bolts, the flanges shall be brought up toward the pipe flanges evenly by partially tightening first the bottom bolt, then the top bolt, then the side bolts and repeating the cycle until all bolts are within the specified torque range. Over stressing of bolts to obtain tightening will not be permitted.
4. Mechanical joints showing visible leakage at the maximum permitted torque shall be disassembled, thoroughly cleaned and reassembled with new gaskets.

E. FIELD LOK GASKET SYSTEM - Field Lok Gasket Systems shall be as manufactured by the U.S. Pipe and Foundry Company or approved equal.
1. These gaskets shall be installed on Tyton Joint Pipe (4" thru 12") and Fittings where specified in the Contract Documents.

F. TR FLEX RESTRAINED JOINT - TR Flex Restrained Joint Pipe shall be as manufactured by the U.S. Pipe and Foundry Company or approved equal.
1. These joints shall be employed where specified in the Contract Documents.
2. TR Flex Pipe shall conform to applicable requirements of ANSI/AWWA C151/A21.51 TR Flex Fittings shall conform to applicable requirements of ANSI/AWWA C110/A21.10.

2.2 CEMENT LINING

A. All ductile iron pipe shall be cement lined. Cement mortar lining shall be in accordance with ANSI A21.4 or latest revision. Thickness of lining shall be as follows:

NOMINAL SIZE OF PIPE	THICKNESS OF LINING*
6", 8", 12"	1/8" Min.
16", 18", 24"	3/16" Min.
30", 36", 42", 48"	1/4" Min.

*A plus tolerance of one eighth (1/8) inch shall be permitted on all size of pipe.

2.3 BOLTED MECHANICAL JOINTS

A. Mechanical joints shall be in accordance with ANSI A21.11 (AWWA C111) and made up with gaskets, glands, and bolts. No short body mechanical joints fittings will be allowed, only full body mechanical joint fittings per specification ANSI/AWWA C110/A21.10. When a joint is to be made up, the bell or socket and plain end shall be cleaned and washed with a solution of mild soap in water as supplied by the pipe manufacturer; the gland and gasket shall be slid onto the plain end then entered into the socket until it is fully "home" in the centering ring. The gasket shall then be painted with soapy water and slid into position, followed by the gland. All bolts shall be inserted and made up hand tight and then tightened with a ratchet wrench. Bolts 180° apart shall be tightened alternately to bring the gland into position evenly. Excessive tightening up of the bolts shall be avoided and torsion wrenches shall be used if needed to prevent excessive tightening. Care shall be taken to assure that the pipe remain fully "home" while the joint is being made up. Where joint restraint is required, the methods specified herein shall be followed.

2.4 JOINT RESTRAINT SYSTEM

A. The Contractor shall provide joint restraint systems to prevent against joint separation of joints on the water main and hydrant connection where restrained pipe is indicated on the drawings and/or as directed by the Engineer. The materials shall be SUPERSTAR, COR-TEN STEEL consisting of tie-bolts, tie-nuts, tie-pins, tie-couplings, tie-clamps, tie-rods, tie-bars, and tie-washers as manufactured by Star National Products, Columbus, Ohio or approved equal. (Certification letter required for COR-TEN STEEL supplied.) Rodding shall include two (2) opposing riser clamps per fitting. The restraint system shall be capable of preventing joint separation for a test pressure of 250 psi or required pressure (for testing 1.5. times working pressure) for each pipe size where restrained pipe is indicated on the drawings and at any additional locations required by Suez Water New York (SWNY) Division. The Contractor may also elect to utilize the MEG-A-LUG restrained joint system as manufactured by EBAA IRON SALES, INC., or approved equal in lieu of the rodding system, however, the required concrete thrust blocks must be installed. The mechanical joint restraint system shall incorporate a restraining mechanism in the follower gland which shall impart a multiple wedging action against the pipe. Glands shall be manufactured of ductile iron conforming to ASTM A536-80. Restraining devices shall be of ductile iron heat treated to a minimum hardness of 370 BHN. All dimensions of each gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to ANSI/AWWA A21.11 and ANSI/AWWA C153/A21.53 of latest revision. Twist-off nuts shall be used to insure proper actuating of the restraining devices. If TR FLEX pipe is utilized, pipe to be restrained shall utilize TR FLEX restrained push-on joint type as manufactured by U.S. Pipe and Foundry Co., or approved equal. Restraint for field cut pipe shall be with TR FLEX GRIPPER RINGS or approved equal. Where GRIPPER RINGS are to be installed on the pipe in the field, the instructions of the pipe manufacturer shall be strictly followed. In addition to the GRIPPER RINGS, the Contractor will install tie-rodding to the first bell on each side of the fittings or valves.

B. Where tie rods are used, the manufacturer's recommendation for the number of rods for size and pressure of main will be followed.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 31 00 00.

3.2 INSTALLATION

A. Inspect pipe and fittings prior to installation to preclude installation of defective materials

B. Install Work in accordance with SWNY Division, the New York State Department of Health and the recommended Standards for Water Works (Ten State Standards) latest Edition.

C. Install piping as shown on the Drawings.

D. All fittings shall be supported independently from the pipe in such a manner that no part of the weight of the fitting is held by the pipe.

E. Fittings and pipe within structures shall be placed to line and grade and properly supported before joints are made. The Contractor shall furnish all the necessary pipe supports, including stirrups, rods, clamps, hangers, pipe columns and piers, necessary to sustain the pipe and fittings in a firm and substantial manner to the lines and grades given.

F. Each valve and valve box shall be installed in accordance with the manufacturers' recommendations or as directed.

G. The Contractor shall construct and install hydrants in the locations shown on the Drawings and/or as directed.

H. Bury piping with depth of cover shown on the Drawings.

I. Install bedding at sides and over top of pipe. Pipe backfill to be installed a minimum of 12-inches overtop of the pipe and compacted in 6-inch loose lifts maximum.

3.3 IDENTIFICATION

A. After the pipe zone and the first 12-inches in the trench zone have been backfilled and compacted, place the marking tape on the compacted backfill and center over the pipe. Run tape continuously along the trench and tie ends of tape together. Wrap marking tape around valve box extension pipes and continue along pipe.

3.4 FIELD QUALITY CONTROL

A. All pipelines carrying water shall be tested for strength and tightness after installation. All testing shall conform to Suez Water New York Division requirements, and AWWA C600, latest edition.

B. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks (if present) have hardened sufficiently or as directed by SWNY. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Test pressure shall be 150 psi or 1.5 times working pressure, whichever is greater, or as directed by SWNY. All aspects of the test, duration, allowable leakage, etc., shall be in accordance with the latest AWWA standards. Use only potable water.

C. Hydrostatic Tests: Test at not less than one-and-one half times working pressure for two hours. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

D. Prepare reports of testing activities.

3.5 CLOSING ABANDONED WATER SYSTEMS

A. Abandoned Piping:

1. Remove underground piping that has been shown to be removed according to the Drawings.

2. Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

   a. Close open ends of piping with at least 8-inch thick, brick masonry bulkheads.

   b. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

3. Backfill to grade according to Section 31 00 00.

3.6 INSPECTION AND ACCEPTANCE

A. Certified physical test reports shall be furnished by the Contractor to the Engineer. In lieu of in-plant inspection, the Engineer may accept such certified physical test reports as evidence of compliance with this section.

3.7 FIELD CUTTING

A. Ductile Iron Pipe shall be cut only by means of abrasive saws, hack saws, wheel type cutters, or milling type cutters. The use of "squeeze" type pipe cutters and cutting torches will not be permitted. The use of diamond points and dog chisels will not be permitted.

3.8 CLEARING AND DISINFECTION

A. Disinfection will be performed after the pipe has passes any leakage tests.

B. The Owner's Representative and Civil Engineer shall be notified at least 48 hours prior to the start of pressure testing, leakage testing, and disinfection.

C. Disinfection will be performed in accordance with the drawings and AWWA C651, excluding Section 5.1 covering the tablet method.

D. Prepare reports of disinfecting activities

END OF SECTION 33 11 01

SECTION 33 11 03

COPPER TUBING AND FITTINGS (UNDERGROUND)

PART 1 GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Earthwork: Section 310000.

B. Water Utility Distribution Valves: Section 331216.

C. Disinfection: Section 331300.

PART 2 PRODUCTS

2.01 MATERIAL

A. Tubing: ASTM B 88, Type K soft temper unless otherwise noted on the drawings.

B. Fittings: Cast Bronze, Flared Type; ANSI/ASME B16.26.

PART 3 EXECUTION

3.01 INSTALLATION

A. Laying Tubing:
   1. Minimum Depth: 4'-6" (unless otherwise indicated on drawings) measured from finish or existing grade, whichever is lower.
   2. Install valves and fittings where indicated. Lay tubing on a continuous slope to a high point where air can be released.

B. Flaring and Assembling Tubing:
   1. Cut tube ends square.
   2. Remove all burrs and metal chips.
   3. Slip coupling nut on tubing.
   4. Flare tubing ends, use impact or mechanical type flaring tools in accordance with manufacturers' recommendations.

5. Assemble tubing fittings and tighten coupling nuts with two wrenches, one on the nut and one on the fitting.

C. Protecting Tubing: Securely close all open ends of tubing and fittings with removable plugs whenever directed by the Owner's Representative.

D. Testing:
1. Before the tubing, valves or other appurtenances are covered, test to 150 pounds hydrostatic pressure. Protect tubing from movement during test.
2. Remove all defective tubing, valves, and fittings. Replace with sound items and make all leaky joints tight. Repeat the test after the repairs are made until no leaks develop when the line is subjected to the required pressure for a period of 30 minutes.
3. All tests shall be made in such manner as the Owner's Representative shall direct and in their presence.

E. Disinfection: After completion of the hydrostatic test, disinfect all piping and fittings in accordance with Section 33 13 00.

END OF SECTION 33 11 03

SECTION 33 12 16 - WATER UTILITY DISTRIBUTION VALVES

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. This Section includes water distribution valves.

B. Related Sections include the following:
1. Section 31 00 00 – Earthwork
2. Section 33 11 01 – Water Utility Distribution Piping.

1.3 REFERENCES

A. Recommended Standards for Water Works (Ten State Standards) latest Edition.

B. "Report, Geotechnical Investigation, Proposed Animal Shelter, Pomona, Rockland County, New York", prepared by Melick-Tully & Associates, dated September 14, 2021.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Comply with requirements of utility company supplying water.
2. Comply with the requirements of the American Water Works Association, AWWA.
   a. C104 – Cement-Mortar Lining for Ductile Iron Pipe and Fittings.
   b. C151 – Ductile Iron Pipe.
   c. C600 – Installation of Ductile Iron Water Mains and Their Appurtenances
3. Comply with Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, "Recommended Standards for Water Works", latest edition.
4. Comply with Occupational Safety and Health Administration, OSHA, Standards 29 CFR, Section 1926, Subpart P and its latest revision.
5. Water and Sewer/Stormwater Line Separations:
   a. Horizontal Separation from Water Mains: 10 feet minimum clear.

b. Vertical Separation from Water Mains: 18 inches minimum clear.
   1) If existing conditions prevent minimum vertical separation:
      a) Construct sewer of PVC pressure pipe material 10 feet on each side of the water main/sewer crossing. The sewer is to be pressure tested.
      b) Encase sewer pipe in concrete, 4 feet on each side of the water main/sewer crossing. Concrete encasement shall be a minimum of 6 inches around the sewer pipe.

c. Where a water main crosses under a sewer, provide adequate structural support for sewer to maintain line and grade.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency. Defective pipe or fittings found after installation shall be removed and replaced by the Contractor at his own expense.

C. Disinfection of water mains and appurtenances: AWWA C651, excluding Section 5.1 covering the tablet method.

D. Inspection of pipes and appurtenances prior to backfilling.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperatures higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane of lift. Rig valves to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points. Unload materials so as to avoid shock or damage. Handle and store all pipe in such a manner as to avoid deterioration or other injury thereto. Place no pipe within pipe of a larger size. Store pipe and fittings on sills above storm drainage level and delivery for laying after the trenches are excavated. Valves and hydrants shall be drained and stored to protect them from damage.

D. Protect flanges, fittings, and specialties from moisture, dirt, and falling debris.

E. Do not store or place materials on private property without written approval from the property owner.

PART 2 - PRODUCTS

2.1 GATE VALVES

A. The gate valves shall be iron body, bronze stem, fusion epoxy coated, resilient wedge gate valve designed for 350 psi working pressure. The valves shall conform to the requirements of the latest edition AWWA Specification C509, with operating nut, and shall turn CLOCKWISE TO OPEN. The valves shall have mechanical joint ends. Valves shall be as manufactured by the Mueller Corp., Series 2361 or approved equal.

2.2 VALVE BOXES

A. Cast iron shall be tough, close grained cast iron, free from blow holes, shrinkage cracks or other defects and shall conform to ASTM Designation A48-36.

B. The Contractor shall furnish and install valve boxes at all buried valve locations. The valve boxes for all main valves shall be as shown on the Suez Water New York Division Standard Details latest revision, suitable for use under heavy traffic. The covers shall be marked "WATER".

C. Valve boxes for water service valves between and including the sizes of 2" (two inch) shall be a two piece adjustable screw type, 5-1/4 inch shaft, size number 21 (twenty-one) with approximately 39" to 48" extension. The boxes shall be as manufactured by Bingham and Taylor "5 ¼" Shaft 2-Piece Valve Boxes – Fig. No. CUL5B64BARC" or approved equal.

D. All valve boxes shall be placed so as not to transmit shock or stress to the valve and shall be centered and plumb over the operating nut of the valve. The ground in the trench upon which the valve box rest shall be thoroughly compacted to prevent settlement. The box shall be fitted together securely and set so that the cover is flush with the proposed finished grade. Prior to final asphalt restoration, the Contractor shall, if necessary, raise or lower the valve box so that the cover is even with the proposed finished grade. If non-rising extension stems are required, the Contractor shall provide at no additional cost to the Owner.

2.3 MISCELLANEOUS METALS

A. Cast iron shall be tough, close grained cast iron, free from blow holes, shrinkage cracks or other defects and shall conform to ASTM Designation A48-36.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The Gate Valves shall be installed as shown on the Contract Drawings. All Valves shall be set plumb. Mechanical joints shall be made as specified in this document. All materials for harnessing the pipe and valve shall be furnished and installed by the Contractor

END OF SECTION 33 12 16

SECTION 33 13 00

DISINFECTION OF WATER UTILITY DISTRIBUTION

PART 1 GENERAL

1.01 QUALITY ASSURANCE

A. Conform to provisions of AWWA C-651 for water line disinfection. Do not use Tablet Method therein.

B. Comply with all requirements of the Rockland County and New York State Department of Health for disinfection of potable water lines, valves, hydrants, storage tanks, and appurtenances.

1.02 SUBMITTALS

A. Contract Closeout Submittals:
   1. Test Results.

PART 2 PRODUCTS

2.01 DISINFECTANT

A. Chlorine Gas meeting AWWA B301.

B. Hypochlorites meeting AWWA B300.

2.02 TEST KITS

A. High range test kit for chlorine residual (0-200 mg/1) Hach Chemical Co. Model CN-21P.

B. DPD chlorine residual test kit (0-3.5 mg/1) Hach Chemical Co. Model CN-66.

C. Test kits to remain property of the Contractor.

PART 3 EXECUTION

3.01 DISINFECTION - WATER MAINS

A. Flush mains with clear water at a minimum rate of 2.5 fps prior to disinfection. See Table 1.

TABLE 1 - WATER MAIN FLUSHING DATA		
PIPE DIAMETER (INCHES)	**FLUSHING RATE GPM @ 2.5 fps**	**HYDRANT OPENINGS @ 40 psi**
2	25	one - 2-1/2
4	100	one - 2-1/2
6	220	one - 2-1/2
8	390	one - 2-1/2
10	610	one - 2-1/2
12	880	one - 2-1/2
14	1200	two - 2-1/2
16	1570	two - 2-1/2
18	1985	two - 2-1/2
24	3525	one - 4-1/2 and one - 2-1/2

B. Chlorine Gas: Apply with a solution-feed chlorinator in combination with a booster pump for injecting the chlorine gas-water mixture into the main. Do not use direct feed chlorinators.

C. Hypochlorites: Apply solutions to water mains with a gasoline or electrically powered chemical feed pump designed for feeding chlorine solutions.

D. Application (Continuous Feed Method).
1. Connect chlorinator or force pump to water main upstream from point of repair or replacement, or new lines.
2. Proportion application rate of chlorine solution to obtain a minimum concentration of 50 mg/1 of available chlorine. Use high range test kit to determine concentration. See Table 2.

TABLE 2 - QUANTITY OF DISINFECTANT REQUIRED FOR 50 mg/l OF AVAILABLE CHLORINE PER 100 FT. OF PIPE							
PIPE DIAMETER (INCHES)	**POUNDS**		**OUNCES**			**QUARTS**	
	Cl GAS	**SOLUTION**	**HYPOCHLORITE**				
		70%	**70%**	**14.7%**	**5.25%**	**14.7%**	**5.25%**
2	0.1	0.1	0.2	0.8	2.1	0.1	0.1
4	0.1	0.1	0.6	3.0	8.3	0.1	0.3
6	0.1	0.1	1.4	6.7	18.7	0.2	0.6

TABLE 2 - QUANTITY OF DISINFECTANT REQUIRED FOR 50 mg/l OF AVAILABLE CHLORINE PER 100 FT. OF PIPE							
PIPE DIAMETER (INCHES)	POUNDS		OUNCES			QUARTS	
	Cl GAS	SOLUTION 70%	HYPOCHLORITE 70%	14.7%	5.25%	14.7%	5.25%
8	0.1	0.2	2.5	11.9	33.2	0.4	1.1
10	0.2	0.3	3.9	18.5	51.9	0.6	1.6
12	0.3	0.4	5.6	26.7	74.7	0.9	2.4
14	0.4	0.5	7.6	36.3	102.0	1.2	3.2
16	0.5	0.7	10.1	47.5	133.0	1.5	4.2
18	0.6	0.8	12.6	60.0	168.0	1.9	5.3
24	1.0	1.4	22.4	107.0	298.0	3.4	9.4

3. In the absence of a meter, determine rate either by placing a pitot gage at discharge or by measuring the time to fill a container of known volume. See Table 3.

TABLE 3 - TIME FOR DISINFECTANT TO FLOW THROUGH 100 FT. OF PIPE - MINUTES			
PIPE DIAMETER (INCHES)	@ 25 GPM	@ 100 GPM	@ 500 GPM
2	0.7	0.2	0.04
4	2.6	0.7	0.13
6	5.9	1.5	0.3
8	10.5	2.6	0.5
10	16.3	4.1	0.8
12	23.5	5.9	1.2
14	32.0	8.0	1.6
16	41.8	10.5	2.1
18	52.9	13.2	2.7
24	94.0	23.5	4.7

4. Continue to apply chlorine solution until it reaches discharge. Check for the presence of chlorine at discharge by adding an orthotolidine reagent. In the presence of chlorine the reagent will turn red.
5. Maintain chlorinated water in the main for a minimum of 24 hours. At the end of this period chlorine concentration shall be at least 25 mg/1. Use high range test kit to determine concentration.
6. Operate all valves and hydrants to insure their proper disinfection.
7. Prevent back flow of super chlorinated water into existing distribution system.

E. Final Flushing:
1. After a 24-hour retention period, flush main until maximum chlorine concentration is 1.0 mg/1. Use DPD chlorine residual test kit.
2. Discharge super chlorinated water in a manner that will not adversely affect plants and animals. Comply with applicable State regulations for waste discharge.

F. Bacteriological Tests: Contact local health units for sampling criteria and procedures. Local health units may have more stringent criteria.
1. Test water main for bacteriological quality before putting pipe into service. A minimum of two successive sets of samples shall be taken at 24-hour intervals. Both sets of samples shall indicate bacteriological safe water before putting the facility in operation. Pay all expenses incurred for testing.
2. Tests shall be conducted by a laboratory approved by the New York State Health Dept.

G. Give all test results to Owner's Representative.
1. Should test results prove any part of the system bacteriologically unsafe, repeat disinfection procedures until satisfactory results are obtained.

END OF SECTION 33 13 00

SECTION 33 31 04 - SANITARY SEWER PIPE

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. This Section includes gravity sewer pipe.

B. Related Sections include the following:
1. Section 31 00 00 – Earthwork.
2. Section 33 11 01 – Water Utility Distribution Piping.
3. Section 33 39 01 – Sanitary Sewer Structures.

1.3 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

1.4 REFERENCES

A. "Report, Geotechnical Investigation, Proposed Animal Shelter, Pomona, Rockland County, New York", prepared by Melick-Tully & Associates, dated September 14, 2021.

1.5 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure-Piping Pressure Ratings: At least equal to system test pressure.

1.6 SUBMITTALS

A. Product Data: Manufacturer's specifications with all pertinent information regarding dimensions, fittings and installation instructions.

1.7 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Comply with standards of authorities having jurisdiction for sanitary sewer piping, including materials, installation, and testing.
2. Comply with Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, "Recommended Standards for Wastewater Facilities", dated 2004, as amended.
3. Comply with Occupational Safety and Health Administration, OSHA, Standards 29 CFR, Section 1926, Subpart P and its latest revision.

4. Water and Sewer Line Separations: See Section 33 11 01 – Water Utility Distribution Piping.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic structures, pipe, and fittings in direct sunlight. Keep plastic items at ambient outdoor temperature.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

D. Inspection: Upon delivery of pipe, inspect pipe.
1. Straightness Tolerance: Maximum deviation of 1/16 inch per foot from straight line drawn between centers of openings.
2. Immediately remove lengths of pipe that fail straightness requirement.
3. Rejection of Manufacturer and Product: Remove all pipe supplied by a manufacturer if more than five percent of shipment is rejected.

1.9 PROJECT CONDITIONS

A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.

B. Locate existing structures and piping to be closed and abandoned.

C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
1. Notify Owner’s representative not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner’s representative’s written permission.

PART 2 - PRODUCTS

2.1 GENERAL

A. Each length of pipe and each fitting shall be marked in accordance with the applicable ASTM Designation.

2.2 DRAINAGE PIPE AND FITTINGS

A. PVC Sewer Pipe and Fittings; (6 inches Diameter and Larger): SDR 35 and ASTM D 3034.

2.3 SOLVENT CEMENTS

A. Solvent cement used for joining plastic pipe and fittings shall meet the following designations for the various types of plastic pipe listed.
   1. PVC: ASTM D 2564.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 310000.

3.2 INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements. Check previously made joints as installation progresses. Maintain swab or drag in line, and pull past each joint as it is completed.

C. Use manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.

D. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Install gravity-flow piping and connect to building's sanitary drains, of sizes and in locations indicated. Terminate piping as indicated.

F. Install piping pitched down in direction of flow, at slope indicated.

G. Install piping with minimum cover as shown on the Drawings.

3.3 PIPE JOINT CONSTRUCTION AND INSTALLATION

A. PVC Sewer Pipe and Fittings: As follows:
   1. Join pipe and fittings with gaskets according to ASTM D2321 and manufacturer's written instructions.
   2. If full entry of pipe joint is not achieved, remove pipe and replace with new unit and gasket.

B. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and that fit both systems' materials and dimensions.

C. Install pipe, fittings, and accessories in accordance with Drawings.

D. Route piping in straight line.

E. Install bedding at sides and over top of pipe in accordance with Drawings.

F. Refer to Section 31 00 00 Earthwork for backfilling and compacting requirements. Do not displace or damage pipe when compacting.

G. Connect to sanitary sewer manholes, pumping stations and existing manhole as shown on Drawings.

H. Install Work in accordance with Quality Assurance standards described above.

3.4 CONNECTIONS TO EXISTING STRUCTURES

A. Core drill existing structures and boot with flexible pipe connector.

3.5 CLOSING ABANDONED SANITARY SEWERAGE SYSTEMS

A. Abandoned Piping:

1. Remove underground piping that has been shown to be removed according to the Drawings.

2. Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:

   a. Close open ends of piping with at least 8-inch thick, brick masonry bulkheads.

   b. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

3. Backfill to grade according to Section 31 00 00.

3.6 FIELD QUALITY CONTROL

A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.

1. Place plug in end of incomplete piping at end of day and when work stops.

2. Flush piping between manholes and other structures to remove collected debris, if required by authorities having jurisdiction.

B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place; after completion of backfill and compaction; and again at completion of Project.

C. Submit separate reports for each system inspection.

1. Defects requiring correction include the following:
    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 95 percent of piping diameter.
    c. Crushed, broken, cracked, or otherwise damaged piping.
    d. Infiltration: Water leakage into piping; maximum of 100 gallons per inch diameter per mile of sewer pipe per day.
    e. Exfiltration: Water leakage from or around piping; maximum of 100 gallons per inch diameter per mile of sewer pipe per day.
2. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
3. Reinspect and repeat procedure until results are satisfactory.

D. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 48 hour advance notice.
4. Submit separate reports for each test.
5. If authorities having jurisdiction do not have published procedures, perform tests as follows:
    a. Infiltration Test: This test may be used only when ground water levels are at least five (5) feet above the top of the pipe for the entire length of the section to be tested during the entire period of the tests. Ground water levels may be measured in an open trench or in standpipes previously placed in backfilled trenches during the backfilling operation. When standpipes are installed in the backfill for ground water measurement, the lower ends of these shall be satisfactorily embedded in a mass of crushed stone or gravel to maintain free percolation and drainage. Infiltration through joints shall be measured by using a watertight weir or any other approved device for volumetric measurement installed at the lower end of the section under test.
    b. Exfiltration Test: This test consists of filling the pipe with water to provide a head of at least five (5) feet above the top of the pipe or five (5) feet above ground water, whichever is higher, at the highest point of the pipe line under test and then measuring the loss of water from the line by the amount which must be added to maintain the original level. In this test the line must remain filled with water for at least twenty-four (24) hours prior to the taking of measurements. Exfiltration shall be measured by the drop of water level in a closed-end standpipe or in one of the sewer manholes available for convenient measuring. When a standpipe and plug arrangement is used in the upper manhole of a line under test, there must be some

positive method of releasing entrapped air in the sewer prior to taking measurements.

c. Low Pressure Air Testing of Piping

1) The Contractor may request, in writing to the Owner's Representative, the substitution of low pressure air testing of the sewer system. Low pressure air testing shall be supervised and certified by a registered New York State Licensed Professional Engineer hired by the Contractor. The test shall satisfy all requirements of the Rockland County Department of Health and the New York State Department of Environmental Conservation Pamphlet TIP 15 (4/19/89).

2) The test length intervals for either type of test shall be as ordered or approved but in no event shall they exceed 1,000 feet. In the case of sewers laid on steep grades, the length of line to be tested by exfiltration at any one time may be limited by the maximum allowable internal pressure on the pipe and joints at the lower end of the line.

3) The test period, wherein the measurements are taken, shall be no less than two (2) hours in either type of test.

4) The total leakage of any section tested by either test method shall not exceed the rate of 100 gallons per mile of pipe per 24 hours per inch of nominal pipe diameter. For purposes of determining the maximum allowable leakage, manhole shall be considered as sections of 48 inch diameter pipe, five (5) feet long, and the equivalent leakage allowance shall be 4.5 gallons per manhole per 24 hours.

5) If leakage exceeds the specified amount, the Contractor shall make the necessary repairs or replacements required to permanently reduce the leakage to within the specified limit and the tests shall be repeated until the leakage requirement is met.

6. Leaks and loss in test pressure constitute defects that must be repaired.

7. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

8. Deflections greater than allowances specified constitute defects that must be repaired.

9. Replace piping using new materials, and repeat test until deflection is within allowances specified.

END OF SECTION 33 31 04

SECTION 33 39 01 - SANITARY SEWER STRUCTURES

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. This Section includes sanitary manholes.

B. Related Sections include the following:
1. Section 31 00 00 – Earthwork.
2. Section 33 11 01 – Water Utility Distribution Piping.
3. Section 33 31 00 – Sanitary Sewer Pipe.

1.3 REFERENCES

A. "Report, Geotechnical Investigation, Proposed Animal Shelter, Pomona, Rockland County, New York", prepared by Melick-Tully & Associates, dated September 14, 2021.

1.4 SUBMITTALS

A. Shop Drawings: Indicate manhole locations, elevations, piping, sizes, and elevations of penetrations.

B. Product Data: Submit cover and frame construction, features, configuration, and dimensions.

C. Design Mix Reports and Calculations: For each class of cast-in-place concrete.

D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Comply with standards of authorities having jurisdiction for sanitary sewer piping, including materials, installation, and testing.
2. Comply with Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, "Recommended Standards for Wastewater Facilities", latest edition.
3. Comply with Occupational Safety and Health Administration, OSHA, Standards 29 CFR, Section 1926, Subpart P and its latest revision.

4. Water and Sewer Line Separations: See Section 33 11 01 - Water Utility Distribution Piping.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.

B. Locate existing structures and piping to be closed and abandoned.

C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
1. Notify Owner's representative not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner's representative's written permission.

PART 2 - PRODUCTS

2.1 MANHOLES

A. Manholes shall be constructed of the sizes and shapes shown and of the types specified complete with frames and covers.

B. Materials
1. Concrete shall comply with the requirements shown on the plans.
2. Brick and brick masonry shall comply with the following:
   a. Brick shall be of the following types:
      1) Type 1 - Manhole Brick
      2) Type 2 - Sewer and Liner Brice
   b. Unless otherwise specified, Type 1 shall be used and shall be either solid or cored, as directed by the Engineer.
      1) Brick shall be of standard size as approved.
      2) Except as otherwise provided herein, brick shall comply with the following requirements:
         a) Type 1 Brick, ASTM Designation C32, Grade MS
         b) Type 2 Brick, ASTM Designation C32, Grade SS
      3) Brick shall be subject to visual inspection. Individual imperfect brick will be rejected for any of the following causes:

a) DEFECTS - The presence of cracks, warpage, stones, pebbles or particles of lime that would affect the serviceability of the brick.
b) IRREGULAR SHAPE - Brick not of rectangular cross-section with substantially straight square corners or where ends and at least one (1) edge do not have plain surfaces.
c) VARIATION IN SIZE - Brick which vary from specified size by more than plus or minus one eighth (1/8) inch in either transverse dimension or by more than plus or minus one quarter (14) inch in length.
d) VARIATION FROM APPROVED SAMPLES - Brick which shall vary from the standard or comparison as established from the approved samples.

3. Frames and covers shall be of cast iron, unless otherwise shown on the Contract Plans, complying with the requirements of the Standard Detail. Include indented top design with lettering "R.C.S.D. No 1" cast into cover.
4. Steps shall be cast iron and shall comply with the requirements shown on the plans.
5. Cement mortar shall comply with the following:
   a. Materials: The cement used in the work shall be of a high quality Portland Cement of a well-established and approved brand and shall conform to the requirements of A.S.T.M. Portland Cement Specifications, Designation C-150, as last amended. Portland Cement type 2 with Darex Additive (one-half (½) ounce per sack of cement) shall be used for Classes "A", "B" and "C" Concrete.
   b. Tests: Provisions of A.S.T.M C-150 as to analysis and test requirements, inspection and rejection will govern. The Engineer will make or cause to be made such of these tests as he deems necessary at the expense of the County and the Contractor will supply without charge all cement samples required.
6. Reinforcement shall comply with the following:
   a. Additional steel reinforcing bars shall be the steel reinforcing bars ordered in writing by the Engineer to be incorporated in the work exclusive of steel reinforcing bars for which payment is provided under separate item. All steel reinforcing bars are to conform to the Standard Specifications for Billet Steel Bars for Concrete Reinforcement, A.S.T.M. Designation A-615, as amended.
   b. Included therein shall be all the steel reinforcing bars placed in pile caps of sewers and structures on piles as shown on the Sewer Design Standards.
   c. Where more than one bar is necessary to complete a required length, the joints shall be made by lapping the ends of the bars for a distance of 40 times their nominal diameters.

C. Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.
   1. Channels: concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
      a. Invert Slope: 2 percent through manhole.
      b. Benches: concrete, sloped to drain into channel.

c. Slope: 4 percent.

2.2 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350R, and the following:
1. Cement: ASTM C150, Type II.
2. Fine Aggregate: ASTM C33, sand.
3. Coarse Aggregate: ASTM C33, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious materials ratio.
1. Reinforcement Bars: ASTM A615/A615M, Grade 60, deformed steel.

C. Structure Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water-cementitious materials ratio. Include channels and benches in manholes.
1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
2. Benches: Concrete, sloped to drain into channel.

2.3 PROTECTIVE COATINGS

A. Description: SSPC-Paint 16, Coltar-epoxy-polyamide 15-mil. minimum thickness, unless otherwise indicated, factory or field applied to the following surfaces:
1. Concrete Manholes: On exterior surface.

2.4 CONNECTIONS TO EXISTING STRUCTURES

A. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 31 00 00.

3.2 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated on Drawings.

B. Form continuous concrete channels and benches between inlets and outlet.

C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere, unless otherwise indicated on Drawings.

D. Install precast concrete manhole sections with gaskets according to ASTM C891.

3.3 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318.

3.4 CONNECTIONS TO EXISTING STRUCTURES

A. Core drill existing structures and boot with flexible pipe connector.

3.5 CLOSING ABANDONED SANITARY SEWERAGE SYSTEMS

A. Abandoned Structures: Excavate around structure as required.

1. Remove structure and close open ends of remaining piping.
2. Backfill to grade according to Section 310000.

3.6 FIELD QUALITY CONTROL

A. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Schedule tests and inspections by authorities having jurisdiction with at least 48 hour advance notice.
3. Submit separate reports for each test.
4. If authorities having jurisdiction do not have published procedures, perform tests as follows:
   a. Both vacuum testing and hydrostatic testing are acceptable means of testing newly constructed sewer manholes. Sanitary sewer manhole testing shall be supervised and certified by a registered New York State Licensed Professional Engineer hired by the Contractor. The testing shall satisfy all requirements of the Rockland County Department of Health and the New York State Department of Environmental Conservation Pamphlet TIP 15 (4/19/89).
   b. The Contractor shall conduct the manhole tests in accordance with Rockland County Department of Health Regulations. The Contractor must hire a Professional Engineer to supervise and verify in writing that the pipe passes to the County of Rockland. All tests shall be witnessed by the County Inspector. The cost of conducting these tests shall be paid for under the unit price bid for the contract on a “per each” unit bid item. No house connections shall be permitted to tie into the new work until these tests have been passed to the satisfaction of the Rockland County Department of Health.

c. The Contractor shall furnish all labor, testing materials and equipment (such as plugs and standpipes) and shall perform the tests described herein under the supervision and to the satisfaction of the Engineer.
d. All tests must be performed in accordance with the requirements of the 2014 Edition of Recommended Standards for Wastewater Facilities established by the Great Lakes-Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers.

5. Leaks and loss in test pressure constitute defects that must be repaired.

6. Replace leaking structure using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION 33 39 01

SECTION 33 39 13 - STORM DRAINAGE STRUCTURES

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. This Section includes the following:
1. Underground stormwater chambers.
2. Trench drains.
3. Drainage Manhole
4. Drainage Cleanout (Refer to Plan)
5. Floor Drain (Refer to Architectural Plans)

B. Related Sections include the following:
1. Section 31 00 00 – Earthwork.
2. Section 33 11 01 – Water Utility Distribution Piping.
3. Section 33 41 05 – Storm Drainage Pipe.

1.3 REFERENCES

A. "Report, Geotechnical Investigation, Proposed Animal Shelter, Pomona, Rockland County, New York", prepared by Melick-Tully & Associates, dated September 14, 2021.

1.4 SUBMITTAL

A. Shop Drawings: Include plans, elevations, details, and attachments for the following:
1. Hydrodynamic separators.
2. Outlet control structures for bioretention.
3. Catch basins.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Water and Sewer Line Separations: See Section 33 11 01 – Water Utility Distribution Piping.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic structures, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle structures according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Engineer not less than 2 days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Engineer's written permission.

PART 2 - PRODUCTS

2.1 HYDRODYNAMIC SEPARATOR

A. The hydrodynamic separators must meet the following specifications:
   1. Contech CDS® CDS2015-4-C.
      a. Size: 48” I.D.
   2. Or approved equal.

2.2 CATCH BASINS, DRAIN INLETS AND YARD DRAINS

A. Catch basins shall be built of the sizes and dimensions and of the types shown on the Plans or as directed by the Engineer. The following shall apply:
   1. The concrete for bases of catch basins shall be deposited continuously for their entire area together with keys. Bases shall be carefully protected from all injury during the progress of the work. The bases of catch basins shall be true and smooth.
   2. Concrete in side walls of catch basins shall be deposited continuously to the height and to the thickness approved and for their entire length.
   3. Concrete in roofs of catch basins shall be deposited continuously for the full depths and for the entire widths and lengths of the roofs. The outer surfaces of roofs shall be finished true and smooth.

B. The location of the catch basins shown on the plans are approximate. The Engineer shall establish the catch basin locations taking into consideration the drainage of the area to the catch basin location and damage to trees or their root system.

C. No basin shall be installed in a location where a pedestrian ramp or driveway depressed curb exists. The minimum distance between a catch basin frame and grating and the end of a depressed curb apron shall be one (1) foot.

D. SETTING FRAMES, GRATES AND COVERS - The brick masonry or concrete for the catch basins shall be built to within such distance of the final grade as shown, specified or ordered. Frames, grates and covers shall be as shown on the plans. The frames shall be set on the masonry or concrete in a full bed of stiff fresh cement mortar.

E. Catch basin connection pipe or catch basin connection pipe openings will not be permitted through the corner of catch basins unless directed otherwise in writing by the Owner's Representative. The distance from the edge of a pipe or an opening to the inside face of the adjoining wall shall be a minimum of 12".

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 31 00 00.

3.2 DRAINAGE STRUCTURE INSTALLATION

A. Install drainage structures in the locations shown on the plans.

B. Set frames and grates to elevations indicated.

C. Brick Masonry
1. The bricks shall be wet when laid and each brick shall be laid in cement mortar so as to form full bed, end and side joints at one operation. The joints shall not be wider than three eighth (3/8) inch, except when the bricks are laid radially, in which case the narrowest part of the joint shall not exceed one quarter (1/4) inch . Brickwork shall be smoothly coated both inside and outside with a layer of cement mortar one-half (1/2) inch thick. Brickwork shall be laid with a satisfactory bond, and as it progresses shall be racked back in courses, unless otherwise permitted.
2. All fresh brickwork shall be carefully protected from freezing and from the drying effects of the sun and wind and, if required, it shall be sprinkled with water at such intervals and for such time as may be directed. Brickwork shall be protected from injuries of all sorts, and all portions which may become damaged or may be found defective shall be repaired or if directed, be removed and rebuilt. In freezing weather, bricks shall be heated sufficiently to remove all ice and frost from laying.

3.3 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24-inches of backfill is in place, and again at completion of Project.
1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:
   a. Alignment: Less than full diameter of inside of pipe is visible between structures.
   b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
   c. Crushed, broken, cracked, or otherwise damaged piping.
   d. Infiltration: Water leakage into piping.
   e. Exfiltration: Water leakage from or around piping.
3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Re-inspect and repeat procedure until results are satisfactory.

3.4 CLEANING

A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.
   1. In large, accessible piping, brushes and brooms may be used for cleaning.
   2. Place plug in end of incomplete piping at end of day and when work stops.

B. Flush piping between manholes and other structures to remove collected debris, if required by authorities having jurisdiction.

END OF SECTION 33 39 13

SECTION 33 41 05 - STORM DRAINAGE PIPE

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. This Section includes storm pipe and fittings.

B. Related Sections include the following:
1. Section 31 00 00 - Earthwork.
2. Section 33 11 01 - Water Utility Distribution Piping.
3. Section 33 39 13 – Storm Drainage Structures.

1.3 DEFINITIONS

A. CPP: Corrugated polyethylene pipe.

B. HDPE: High-density polyethylene plastic.

C. LLDPE: Linear low-density polyethylene.

D. NPS: Nominal pipe size.

E. PVC: Polyvinyl chloride plastic.

1.4 REFERENCES

A. “Report, Geotechnical Investigation, Proposed Animal Shelter, Pomona, Rockland County, New York”, prepared by Melick-Tully & Associates, dated September 14, 2021.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic structures, pipe, and fittings in direct sunlight. Keep plastic items at ambient outdoor temperature.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

D. Inspection: Upon delivery of pipe, inspect pipe.

1. Straightness Tolerance: Maximum deviation of 1/16 inch per foot from straight line drawn between centers of openings.
2. Immediately remove lengths of pipe that fail straightness requirement.
3. Rejection of Manufacturer and Product: Remove all pipe supplied by a manufacturer if more than five percent of shipment is rejected.

1.6 SUBMITTALS

A. Product Certification: Pipe, fittings, precast concrete units, metal items, and miscellaneous appurtenances.

B. Product Data: For the following:
1. Pipe.

1.7 QUALITY ASSURANCE

A. Regulatory Requirements:
1. Water and Sewer Line Separations: See Section 33 11 01 – Water Utility Distribution Piping.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic structures, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

1.9 PROJECT CONDITIONS

A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.

B. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Engineer not less than 2 days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Engineer's written permission.

PART 2 - PRODUCTS

2.1 HDPE PIPE AND FITTINGS

A. High Density Polyethylene Pipe (HDPE) Smooth Interior Pipe:
1. Pipe and Fittings: Shall conform to AASHTO M252 and M294 and/or ASTM F2360 unless otherwise shown on the Drawings.
2. Gaskets: Rubber gaskets shall meet requirements of ASTM F477 with joints conforming to AASHTO M294, watertight designations, or ASTM F 2306.
3. Maximum permitted diameter is 48".

4. See Section 310000 – Earthwork and drawings for bedding details.
5. HDPE Pipe shall be NTPEP Certified.
6. Approved Manufacturers:
   a. Advance Drainage Systems, Inc., 3300 Riverside Drive, Columbus, Ohio 43221 (614) 457-3051
   b. Hancor, Inc., 401 Olive Street, Findlay, Ohio 45840 (888) 367-7473
   c. Lane Enterprises, Inc. (for Type S Lok-Tite Pipe) 3905 Hartzdale Drive, Suite 514, Camp Hill, PA 17011 (717) 761-8175
   d. Or approved equal.

2.2 PVC PIPE AND FITTINGS

A. ASTM D3034 SDR35 Poly Vinyl Chloride (PVC) Pipe and Fittings, AASHTO M278, 4-inch to 10-inch perforated pipe, with 3/8-inch perforations at 3-inches on center, solid connectors.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 31 00 00.

3.2 PIPING INSTALLATION

A. Locations and Arrangements: Contractor shall install all drainage structures and pipe in the locations shown on the drawings and/or as approved by the Owner. Pipe shall be of the type and sizes specified on the drawings and shall be laid accurately to line and grade. Structures shall be accurately located and properly oriented. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, on prepared foundation, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Lap joint pipes shall be laid with the inside circumferential laps pointing downstream and with the longitudinal laps at the side or quarter points.

C. Manholes, catch basins and drain inlets shall be constructed as soon as the pipe laying reaches the location of the structures. If the Contractor continues pipe installation without making provisions for completion of the structures the Owner shall have the authority to stop the pipe installation until the structure is completed.

D. Any structure which is miss-located or oriented improperly shall be removed and reconstructed at its proper location, alignment and orientation without cost to the Owner.

E. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing storm drainage is indicated.

F. Precast drainage structures shall be assembled in accordance with the manufacturer's instructions to form a sound structural unit.

G. Cast-in-Place drainage structures shall be installed in accordance with the details or referenced specifications shown on the drawings. Concrete shall comply with the requirements of this section.

H. Fittings and Connections:
1. Water-Tight: Pipe connections to drainage structures for water-tight (resilient) conditions shall meet ASTM F2510/F2510M for HDPE pipe, or ASTM C 923 for reinforced concrete pipe. Grout, if used for water-tight connection shall be Non-Shrink type only.
2. Bottom invert connections shall be constructed of concrete form smooth to provide a bench between pipe inverts unless otherwise detailed on the plans.

I. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

J. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of micro-tunneling.

K. Install gravity-flow, non-pressure drainage piping according to the following:
1. Install piping pitched down in direction of flow.
2. Install piping NPS 6 (DN 150) and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
3. Install piping with 24-inch minimum cover.
4. Install HDPE piping according to pipe manufacturer's installation guidelines for heavy duty drainage applications and ASTM D 2321.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping according to the following:
1. Join HDPE pipe according to ASTM D 2321
2. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
3. Join dissimilar pipe materials with nonpressure-type flexible couplings.

3.4 FIELD QUALITY CONTROL

A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.
1. In large, accessible piping, brushes and brooms may be used for cleaning.
2. Place plug in end of incomplete piping at end of day and when work stops.
3. Flush piping between manholes and other structures to remove collected debris, if required by authorities having jurisdiction.

B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:
   a. Alignment: Less than full diameter of inside of pipe is visible between structures.
   b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 95 percent of piping diameter.
   c. Crushed, broken, cracked, or otherwise damaged piping.
   d. Infiltration: Water leakage into piping.
   e. Exfiltration: Water leakage from or around piping.

C. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.

D. Re-inspect and repeat procedure until results are satisfactory.

END OF SECTION 33 41 05

SECTION 34 71 13

VEHICLE GUIDE RAILS

PART 1 GENERAL

1.01 REFERENCE STANDARDS

A. New York State Department of Transportation (DOT) Specification section 606 dated September 1, 2021.

B. New York State Department of Transportation (DOT) Specification section 710-14 dated September 1, 2021.

C. New York State Department of Transportation (DOT) Specification section 710-20 dated September 1, 2021.

D. New York State Department of Transportation (DOT) Standard Sheet 606-07 approved on January 2, 2020.

1.01 SUBMITTALS

A. Shop Drawings: Show application to project. Include joint and connection details and erection drawings.

PART 2 PRODUCTS

2.02 STEEL RAILS AND POSTS

A. Rail Element: The rail element shall meet the requirements of DOT Specification Section 710-20 and the dimensions specified on DOT Standard Sheet 606-07.

B. End Section: 12 gage corrugated galvanized (ASTM A 123) steel plate curved to extend a minimum of 10 inches in back of rail face.

C. Posts: Posts shall be steel I-beam posts meeting the requirements of DOT Specification Section 710-14.

2.03 HARDWARE

A. Steel Shapes and Plates: Steel plates and shapes shall conform to ASTM A 36 and meet the requirements of DOT Specification Section 710-20.

B. Bolts and Nuts: Bolts shall conform to ASTM A307 Grade A and meet the requirements of DOT Specification Section 710-20.

C. Galvanized Finish: Hardware shall be galvanized in accordance with the requirements of DOT Specification Section 719-01 Galvanized Coatings and Repair Methods, Type II (ASTM A 153).

PART 3 EXECUTION

3.01 INSTALLATION

A. Posts:
1. Steel: Drive posts using approved equipment that will set posts in final position free of distortion, burning or other damage.

B. Rails: Attach to posts as indicated with the alignment resulting in a smooth continuous rail.

END OF SECTION 34 71 13