TECHNICAL SPECIFICATIONS

SECTION 01010

SUMMARY OF WORK

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Project - Work covered by Contract Documents.

B. Limits of work area.

C. Construction permits and easements.

D. Work sequence.

E. Quality assurance.

F. Preconstruction conference.

G. Progress meetings.

1.02. WORK INCLUDED

A. The Contractor shall furnish and install all general construction work items required to complete the designs and intent of the drawings and specifications for the unit prices or lump sum prices for this Contract.

B. All work listed is inclusive of the Union Hill Pump Station and Tallman Pump Station, unless otherwise specified.

C. In general, the principal items of work under this Contract include but are not necessarily limited to the following:

1. Mobilization.

2. Provide all required soil erosion and sediment control measures.

3. Provide construction survey to verify existing elevations.

4. Complete exploratory excavations to confirm the location of existing utilities.

5. Maintain operation and provide maintenance of existing pump room sump pumps.

6. Demolish the four influent pumps and pump bases, motors and motor bases, pump shafts and shaft bearing supports at the pump stations.

7. Provide four influent pumps and pump bases, motors and motor bases, pump shafts and shaft bearing supports at the pump stations.

8. Demolish pump suction and discharge valves and piping, including piping within the existing wet wells, surge valves, pump discharge header, miscellaneous interior and exterior process piping, and pipe supports.

9. Provide new pump suction and discharge valves and piping, including piping within the existing wet wells, surge valves, pump discharge header, miscellaneous interior and exterior process piping, and pipe supports.

10. Provide bypass pumping during construction of the work to maintain flow from pump stations.

11. Remove and replace air relief and cleanout valves in the air relief and clean out manholes/chambers. Add new air relief valves and cleanout valves as they are shown on the drawings.

12. Provide line bypass during replacement of the air relief and cleanout valves.

13. Provide miscellaneous architectural and structural work, including modification to pipe supports, epoxy wall injection, new pipe supports, equipment pads, and removal and replacement of doors and windows.

14. Asbestos abatement work and lead paint removal, as necessary.

15. Demolish existing interior stair guard rail on the upper floor. Install new wall.

16. Provide a new Union Hill Station Control Panel (UH-PLC) and Tallman Station Control Panel (TA-PLC).

17. Provide new bubbler systems and associated control panels.

18. Provide variable frequency drives (VFD) for the four influent pumps.

19. Demolish existing isolation transformers.

20. Demolish existing electrical equipment including conduit, wire, lighting, disconnects, switchboards, panelboards, MCC's, and concrete pads as required.

21. Provide new electrical equipment, including but not limited to, pump distribution switchboard (PDS), disconnects, MCC's, panelboards and cabling.

22. Provide wiring to new variable frequency drives.

23. Provide all new conduit and cabling. Terminate cables to all equipment.

24. Provide new lighting.

25. Perform all other electrical and instrumentation work required for the complete and satisfactory completion of the pump station upgrades.

26. Demolish existing HVAC equipment including heaters, fans, ductwork, louvers, dampers, air handler, etc.

27. Provide new ventilation, heating and air conditioning units.

28. Provide all new ductwork, louvers and dampers.

29. Perform all other heating and ventilation work required for the complete and satisfactory completion of the pump station upgrade.

30. Demolish existing plumbing piping, valves, supports, etc.

31. Provide new plumbing piping supports and valves.

32. Demolish existing bathroom fixtures, lighting, ventilation and lighting in the bathroom at the Union Hill Pump Station.

33. Provide new bathroom fixtures, lighting, ventilation and lighting in the bathroom at the Union Hill Pump Station.

34. Perform all other plumbing work required for the complete and satisfactory completion of the pump station upgrades.

35. Provide testing, startup, and training.

36. Cleanup and demobilization.

37. Provide shop drawings and other submittals, testing documentation, O&M Manuals, coordination drawings and as-built drawings.

38. Perform all other work required for the complete and satisfactory completion of the pump station upgrades.

1.03 PERMITS, CERTIFICATIONS, AND OTHER AGENCY REQUIREMENTS

A. Contractors shall obtain and pay for necessary construction permits from those authorities and agencies having jurisdiction over land areas, utilities, or structures which are located within the contract limits and which are occupied, encountered, used, or temporarily interrupted by Contractor's operations.

The Owner has obtained the following agreement:

OWNER	Agreement
Norfolk Southern	Railroad Crossings*

*Contractor must still apply for work permit, which includes insurance and force accounts for the railroad.

B. When construction permits are accompanied by regulations or requirements issued by a particular authority or agency, it shall be Contractor's responsibility to familiarize himself and comply with such regulations or requirements as they apply to his operations on this project. Contractor is also responsible for any insurance or bonding requirements as detailed in individual permits.

C. Additional Field Supervision

1. Any costs associated with this additional field supervision or any other authorities' or agencies' additional field supervision (including railroads) shall be the Contractor's responsibility.

2. Contractor shall deposit the required dollar amount into the Norfolk Southern Railroad (NSR) force account. Contractor may submit for reimbursement showing proof that force account has been paid. Contractor will be responsible for scheduling NSR flagmen. Contractor will ensure that all required material and equipment is available prior to scheduling the NSR. Any NSR costs accrued shall be the sole responsibility of the Contractor while the Contractor is unable to perform pertinent work due to malfunctioning equipment or any and all other causes. If Contractor schedules the NSR flagmen and does not work on the days scheduled, Contractor shall be

responsible for the NSR costs. If the Contractor damages or causes harm to the NSR, Contractor shall be responsible for the NSR costs. This section specifically applies to the NSR force account. All other sections still apply.

3. Field supervision and notification to railroad is required when working on railroad property and within 150 feet of railroad property.

D. Contractor shall be responsible for all traffic control requirements shown on plans. Contractor shall use the contract drawings as a basis for a traffic control plan; however, the Contractor is responsible for developing a final traffic control plan that is subject to review and approval from the appropriate road owner.

E. Contractor is responsible to submit a plan for temporary support of any existing utilities encountered during construction as required by the utility owner. Design shall be stamped by a New York State licensed professional engineer and be submitted for approval to the utility owner.

F. Contractor shall not be permitted to use water from a hydrant unless written permission is obtained from the water utility owner.

1.06. LIMITS OF WORK AREA

A. Confine construction operations within the Contract Limits shown on the Drawings. Storage of equipment and materials, or erection and use of sheds outside of the Contract Limits, if such areas are the property of Owner, shall be used only with Owner's approval. Such storage or temporary structures, even within the Contract Limits, shall be confined to Owner's property and shall not be placed on properties designated as easements or rights-of-way.

1.07. CONSTRUCTION PERMITS AND EASEMENTS

A. The Contractor shall obtain and pay for necessary construction permits from those authorities, agencies, or railroads having jurisdiction over land areas, utilities or structures which are located within the Contract Limits and which will be occupied, encountered, used, or temporarily interrupted by Contractor's operations.

B. When construction permits are accompanied by regulations or requirements issued by a particular authority or agency, it shall be Contractor's responsibility to familiarize himself and comply with such regulations or requirements as they apply to his operations on this project. Any costs associated with additional field supervision by authorities or agencies shall be the Contractor's responsibility.

C. Working under or storage of materials under electrical power lines is not permitted.

1.08. WORK SEQUENCE

A. The work sequence shown below is for the entire project. Individual contractors to coordinate sequencing of work in accordance with General Contract Conditions. The Contractor must provide a proposed sequence of work plan for approval and may propose modifications to this work sequence for Owner and Engineer approval.

1. Verify pump stations are in operation. Provide required temporary ventilation system to wetwell.

2. Provide pump station bypass pumping and piping system. Bypass pumping shall not commence until the complete bypassing system equipment and the new equipment including slide gates, pumps, piping, valves and other appurtenances, control panels, MPDS, MCC's and other electrical equipment necessary for pump operation are on site and ready for installation to minimize the bypass pumping period. Existing process drains and recycle must remain operable during the entire project construction period.

3. Provide temporary power for pump floor, motor floor, and all roof equipment, including emergency power.

4. Maintain operation and provide maintenance of existing pump room sump pumps throughout project duration.

5. Proceed with Union Hill and Tallman Pump Station work.

6. Demolish existing pumps, motors, shafts, shaft bearing supports, suction and discharge piping, pipe header, valves, and pump bases.

7. Create new wall openings in wetwell wall and remove and replace existing suction piping in wetwell, including modifications to existing concrete fillets and pipe supports. Only one wall opening is allowed to be cut into the existing wall at a time.

8. Install new pump distribution switchboard, MCC's, pump VFD's, panelboards, and new control panels in Electrical Room. Remove temporary electrical systems following successful startup and testing of new electrical equipment.

9. Install all pumps, motors, shafts, shaft bearing supports, suction and discharge piping, valves, header, pipe supports and electrical power and controls.

10. Complete individual testing of all pumps and associated equipment through existing force main to grit building. Turn off bypass pumping system during testing.

11. Complete testing of multiple pumps together, up to 3 pumps, through existing force main to discharge. Turn off bypass pumps during testing.

12. Complete installation, startup and required testing of all remaining project components.

13. Remove bypass pumping and piping systems after successful testing and acceptance of new pump and piping systems.

14. Proceed with removal and replacement of air relief and clean out valves in manholes. Do not remove existing valves until the bypass piping is in place.

15. After replacement, remove bypass piping.

16. Complete all remaining work under the contract.

1.09. QUALITY ASSURANCE

A. The entire Contract work shall be completed in strict accordance with all applicable federal, state and local regulations and ordinances and the best standards of practice.

1.10. PRECONSTRUCTION CONFERENCE

A. Engineer will schedule a pre-construction conference after the Effective Date of Agreement.

B. Attendance Required - Owner, Engineer, Contractor, and each major subcontractor.

C. Agenda

1. Submission by Contractors of list of Subcontractors, list of products, Schedule of shop drawings and other submissions, Schedule of Values, and progress schedule.

2. Designation of personnel representing the parties in Contract and the Engineer.

3. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders and Contract closeout procedures.

4. Scheduling.

5. Scheduling activities of testing laboratory.

6. Requirements of regulatory agencies.

7. Use of premises by Owner and Contractor.

8. Temporary facilities to be provided by Owner; and by Contractor.

9. Procedures for testing.

10. Procedures for maintaining record documents.

11. Maintenance of vehicular traffic detours, flagmen, etc.

12. Periodic cleanup of site.

13. Notification of utilities' owners.

D. Engineer will record minutes and distribute copies within 14 days after meeting to participants, and to those affected by decisions made.

1.11. PROGRESS MEETINGS

A. Engineer will schedule and administer meetings throughout progress of the Work at monthly intervals, or as needed.

B. Engineer will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings, record minutes, and distribute copies within ten days to participants, and those affected by decisions made.

C. Attendance Required - Owner, Engineer, Contractor's job superintendent, major Subcontractors and suppliers, as appropriate to agenda topics for each meeting.

D. Agenda

1. Review minutes of previous meetings.
2. Review of Work progress.
3. Field observations, issues, and decisions.
4. Identification of items that impede planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of off-site fabrication and delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on progress schedule and coordination.
13. Other business relating to Work.

1.12. INTERFERENCE WITH EXISTING FACILITIES AND OTHER ONGOING ACTIVITIES

A. The Owner's facilities identified in Article 1.02 and flow through the plant must be maintained in continuous operation at all times during the course of the work under this Contract. Any interruptions to the service of or modification of existing equipment must be carried out in cooperation with the Owner and shall not be carried out during rainy weather or other periods of high wastewater flow.

C. The costs associated with the interferences, coordination and interfacing with other contractors as well as the Owner shall be included in the Contract Price.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01150

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01. ESTIMATES AND PAYMENTS

A. The Contractor shall make applications for progress payments to the Engineer in accordance with the General Contract Conditions and these Contract Documents. The final payment will be made upon acceptance by the Owner and as otherwise stipulated in the Contract Documents.

1.02. ESTIMATED QUANTITIES

A. The items listed below refer to and are the same Bid Items listed in the Bid Form. They constitute all of the Bid Items for the completion of the Work. No direct or separate payment will be made for providing miscellaneous temporary or accessory works, plant, services, Contractor's field offices, layout surveys, job signs, sanitary requirements, testing, safety devices, submittals and record drawings, water supplies, power, removal of waste, watchmen, bonds, insurance and all other requirements of the General Contract Conditions and all other requirements of the Contract Documents. Compensation for all such services, labor, equipment and materials shall be included in the prices stipulated for the Bid Items listed herein.

B. The estimated quantities for unit price Bid Items are approximate only and are included solely for the purpose of comparison of Bids. The Owner does not expressly or by implication agree that the nature of the materials encountered below the surface of the ground or the actual quantities of material encountered or required will correspond therewith and reserves the right to increase or decrease any quantity or to eliminate any quantity as Owner may deem necessary. Contractor will not be entitled to any adjustment in a unit bid price as a result of any change in an estimated quantity and agrees to accept the aforesaid unit bid prices as complete and total compensations for any additions or deductions caused by a variation in quantities as a result of more accurate measurements, or by any changes or alterations in the work ordered by the Owner, and for use in the computation of the value of the work performed for progress payments.

C. Each unit bid price and lump sum bid price shall be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

1.03. MEASUREMENT AND PAYMENT

A. Payment for the items included in this Contract shall be for the work actually performed and accepted and according to the unit prices or lump sums listed in the Bid Proposal and as specified herein.

B. No payment will be made for lost, damaged, spoiled or broken tools, equipment, materials, etc., normally involved in the operations and progression of the work.

C. For the Contractor's complete performance of the Work, the Owner will pay, and the Contractor agrees to accept, subject to the terms and conditions of the Contract Documents, the lump sum price or unit prices at which the Contract was awarded, plus or minus the amount required to be paid or credited for any extra work or work deleted as ordered by the Owner.

D. The sum total for these items shall constitute full payment for the work completed, tested and ready for use, including all work required, but not specifically mentioned in the Bid Items, and also for all losses or damages arising out of the nature of the work or from the action of the elements, or from any unforeseen difficulty encountered in the prosecution of the Work, and for all risks of every description connected with the Work, and for all expenses incurred by or in consequence of the suspension or discontinuance of the Work herein specified, and for any actual or alleged infringement of patent, trademark or copyright and for well and faithfully completing the Work as herein provided.

E. The Contractor shall include with each partial payment request the following items, the inclusion of which shall be a prerequisite for the review of the application by the Engineer. Failure to submit any of the required documentation below shall result in the payment request being incomplete and it will be returned unreviewed:

1. Certified payroll records

2. Affidavit attesting to the payment of subcontractors, suppliers, labor, equipment, material, services. etc.

3. Revised and updated accurate project schedule.

4. Progress photos.

5. EEO documentation.

6. M/WBE Contractor Compliance (Monthly) Report.

7. Up-to-date As-Built drawings.

8. Any other documentation the Engineer may require.

F. The monthly estimate, as approved by the Engineer, will be considered approximate and no claim shall be made by the Contractor for additional payment based on any error in a periodical estimate.

1.04. BID PROPOSAL ITEMS

A. Refer to Bid Item Descriptions following this specification.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

(continued)

LUMP SUM ITEM
BID ITEM 1 - MOBILIZATION/DEMOBILIZATION

A.	DESCRIPTION	Under this Item, the Contractor shall provide work including mobilization and maintenance of forces and general equipment. The Contractor shall also provide and update schedules; submit shop drawing information; attend meetings; implement a Safety, Health, and Emergency Response Plan; construct facilities and temporary controls; provide general quality control; provide bonding and insurance; provide and maintain erosion control; and complete miscellaneous work shown on the Drawings, but not included on other Bid Items.
B.	WORK INCLUDED UNDER THIS ITEM	All work detailed within General Contract Conditions All items not included under other Bid Items
C.	ASSOCIATED WORK NOT INCLUDED UNDER THIS ITEM	Work required under other Bid Items
D.	METHOD OF PAYMENT	Payment shall be made based on the percentage of the overall project completed as reflected in each partial payment request up to 90% of the lump sum for Bid Item 1. Contractor shall be allowed to request up to 20% of the value of Bid Item 1 in the initial progress payment application. The final 10% of Bid Item 1 shall be withheld until the final payment for the project. The total value for Bid Item 1, Mobilization/ Demobilization, shall not exceed 10% of the total contract award.

LUMP SUM ITEM
BID ITEM 2 - CONSTRUCTION

A.	DESCRIPTION	Under this Item the Contractor shall furnish materials and construct the Union Hill and Tallman Pump Station Upgrades, air relief valves, cleanouts, and line stops as called for in the Contract Documents and as outlined below.
B.	WORK INCLUDED UNDER THIS ITEM	General Contract Conditions Supplemental Contract Conditions Contract Drawings Technical Specifications Appendices
C.	ASSOCIATED WORK NOT INCLUDED UNDER THIS ITEM	All other Bid Items
D.	METHOD OF PAYMENT	Payment shall be made on a lump sum basis in accordance with the Contractor's pay item breakdown. Breakdown shall include as a minimum all items listed under "B" above.

STIPULATED LUMP SUM ITEM
BID ITEM 3 - MISCELLANEOUS ADDITIONAL WORK

A.	DESCRIPTION	Under this Item, the Contractor shall furnish all labor, materials, and equipment necessary and perform all work necessary to repair existing concrete cracks encountered during the course of the work or where directed by the Engineer.
B.	WORK INCLUDED UNDER THIS ITEM	Only miscellaneous additional work performed by the contractor which has been authorized by the Engineer and Owner prior to its commencement.
C.	ASSOCIATED WORK NOT INCLUDED UNDER THIS ITEM	All other Bid Items
D.	METHOD OF PAYMENT	This bid item has a stipulated fixed price of $250,000. The total amount paid to the Contractor will be determined in accordance with the provisions of Article 84 of the General Contract Conditions, Pricing of Changes, and such payment will include only that overhead and profit that is applicable to the work performed under this Item. Only work authorized in writing will be paid for.

UNIT PRICE ITEM
BID ITEM 4 – CONCRETE CRACK REPAIR

A.	DESCRIPTION	Under this Item, the Contractor shall furnish all labor, materials, and equipment required to accomplish miscellaneous additional work necessitated by unforeseen conditions encountered during the work, field conditions of a nature not determinable during design or for which no unit prices are applicable.
B.	WORK INCLUDED UNDER THIS ITEM	Cleaning Preparation of the concrete crack for repair material Furnish and install concrete repair material Protection of work Furnish and Install concrete sealant
C.	ASSOCIATED WORK NOT INCLUDED UNDER THIS ITEM	All other Bid Items
D.	METHOD OF PAYMENT	Payment for this Item shall be based on a unit price per linear feet basis.
E.	MEASUREMENTS AND LIMITS	The quantity for which payment will be made shall be the total number of linear feet of concrete cracks repaired as specified and as measured in place by the Engineer.

BID ITEM DESCRIPTION BI-5

UNIT PRICE ITEM
BID ITEM 5 - WET WELL RESIDUAL DEBRIS AND GRIT

A.	DESCRIPTION	Under this Item, the Contractor shall furnish all labor, materials, and equipment required to remove and dispose of all wet well debris and grit encountered during the work.
B.	WORK INCLUDED UNDER THIS ITEM	Protection of existing facilities Debris/grit removal and disposal Cleaning Dewatering of debris and grit as necessary
C.	ASSOCIATED WORK NOT INCLUDED UNDER THIS ITEM	All other Bid Items
D.	METHOD OF PAYMENT	The quantity for which payment will be made shall be the total cubic yards of debris and grit removed and disposed of as measured (depth, length, and width) as measured in-place in the wet well.

BID ITEM DESCRIPTION BI-6

STIPULATED LUMP SUM ITEM
BID ITEM 6 - RECORD DOCUMENTS

A.	DESCRIPTION	Under this Item, the Contractor shall furnish record documents for all work performed in this contract as stated in the specifications.
B.	WORK INCLUDED UNDER THIS ITEM	General Contract Conditions Supplemental Construction Conditions Specification Section 01700
C.	ASSOCIATED WORK NOT INCLUDED UNDER THIS ITEM	All Other Bid Items
D.	METHOD OF PAYMENT	This bid item has a stipulated fixed price of $75,000.

STIPULATED LUMP SUM ITEM
BID ITEM 7 – RAILROAD FORCE ACCOUNT

A.	DESCRIPTION	Under this Item, the Contractor shall schedule and pay for Norfolk-Southern Railroad fees as described in the agreement.
B.	WORK INCLUDED UNDER THIS ITEM	Depositing Funds into Force Account Engineering and Administration Transportation (Scheduling of Flagmen) Maintenance of Way Ensure all Required Material and Equipment is Available Prior to Scheduling of Flagmen General Contract Conditions Supplemental Construction Conditions Specification Section 01540
C.	ASSOCIATED WORK NOT INCLUDED UNDER THIS ITEM	All Other Bid Items
D.	METHOD OF PAYMENT	This bid item has a stipulated fixed price of $600,000.

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Submittal procedures.

B. Review of submittals.

C. Schedule of submittals.

D. Proposed products list.

E. Shop drawings.

F. Samples.

G. Manufacturers' instructions.

H. Manufacturers' certificates.

1.02. SUBMITTAL PROCEDURES

A. Transmit each required submittal using Engineer-accepted form.

B. Number the submittals as follows:

1. First - Specification section number.

2. Submittal number within the specification section.

3. Review cycle number.

4. Title of submittal.

For example:

15073-01-01 - Field lock gaskets for DIP (first review cycle) 15073-01-02 - Field lock gaskets for DIP (second review cycle) 15073-02-01 - Flange pipe and fittings (first review cycle) 15073-02-02 - Flange pipe and fittings (second review cycle) 15073-02-03 - Flange pipe and fittings (third review cycle).

C. Identify project, Contractor, subcontractor or supplier; pertinent Drawing sheet and detail number(s), and specification section number, as appropriate.

D. Apply Contractor's stamp, signed or initialed certifying that review, verification of products required, field dimensions, adjacent construction work, and coordination of information, is in accordance with the requirements of the work and Contract Documents. Stamp shall show the following information:

1. Shop Submittal Number ___

2. Deviations: None___; As Listed_____

3. Reference Specification Number ___

4. Reference Drawing Number_____

5. Space Requirement: As Designed _Different, As Listed_____

6. Representation is made to the Owner and Engineer that the Contractor has determined and verified all field measurements and quantities, field construction criteria, materials, catalog numbers and similar data, that he has reviewed and coordinated the information in each shop drawing with the requirements of the work and the Contract Documents, and hereby approves this submittal.

   Contractor_____

   Signature_____

   Date_____

E. All submittals shall be submitted electronically. All submittals shall be in PDF format. All files shall be combined into a single bookmarked file for easier review.

F. Identify deviations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed work.

G. Identify space requirements which differ from those designed or shown on the Contract Documents.

H. Revise and resubmit in accordance with the requirements of this section. Identify all changes made since previous submittal in a cover letter or memorandum

I. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.

J. Submittals not requested will not be recognized or processed.

K. Submittals for which a Performance Affidavit is required by the individual specification section or Section 01640, Equipment-General, will not be reviewed until an acceptable Performance Affidavit is included.

L. Items shall not be fabricated or delivered without fully approved shop drawings.

M. Ensure no associated work begins until associated shop drawings are fully approved.

N. Fabrication erection, setting or other work done prior to receiving an “Approved” or “Approved as Corrected – No Resubmittal Required” is at Contractor’s risk.

1.03. REVIEW OF SUBMITTALS

A. Review of submittals will be in accordance with the requirements of this section.

B. Review Times

1. No less than 21 days shall be allowed for Engineer's review of submittals and resubmittals unless otherwise specified in the Contract Documents.

2. No less than 28 days shall be allowed for Engineer's review of Division 17 submittals and all other items including PLC-based control systems.

C. Review Codes

1. Approved.

2. Approved as Corrected – No Resubmittal Required.

3. Approved as Corrected – Resubmittal Required.

4. Approved as Corrected – Provide Requested Information Only.

5. Revise and Resubmit.

6. Not Approved.

7. For Informational Purposes Only.

D. Payment will not be made for any items requiring submittals until no further submittals are required for the item

1.04. SCHEDULE OF SUBMITTALS

A. Submit one electronic copy of the preliminary Schedule of Submittals.

B. Revise and resubmit until acceptable to Engineer.

1.05. PROPOSED PRODUCTS LIST

A. Within 10 days after date indicated in the Notice to Proceed, submit complete list of major products proposed for use, with name of manufacturer, trade name, and model number of each product, and appropriate specification section number.

B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

C. Submit all "or-equal" and substitution items in accordance with the requirements of the General Conditions.

1.06. SHOP DRAWINGS

A. Contractor shall submit for review by the Engineer shop drawings of all fabricated work and for all manufactured items and materials required to be furnished in the Contract and as required by the specifications. Provide information in accordance with this section and as required by individual specification sections.

B. Before submission of each shop drawing, including all drawings submitted by the Contractor's, Subcontractors and suppliers of materials and equipment included in the Contractor's contract, the Contractor shall have determined and verified all quantities, dimensions, specified performance, installation requirements, materials, catalog numbers and similar data with respect thereto.

C. Equipment manufacturers supplying equipment for the project shall examine the Plans and Specifications pertaining to their particular equipment in order to be fully acquainted with the operating conditions to which the equipment will be subjected.

D. Shop drawing submittals shall include all descriptive data, performance characteristics, material specifications, spare parts list, drawings, piping diagrams, wiring schematics, and shall be complete and accurate to indicate item-by-item compliance with the Contract Documents.

E. Shop drawings, showing the layout of equipment, piping, fixtures, conduit runs, electrical gear, ducting and all fabricated and manufactured items for inclusion into the project, shall be drawn and submitted at the scale used on the contract drawings for the Plan, Sectional Plans, Sections and Details for that particular building or installation. Contract drawings shall not be reproduced by mechanical, chemical or photographic methods and resubmitted as "shop drawings".

F. All catalog cuts, manufacturer's specifications, drawings, and verbal descriptions shall be clearly marked to allow identification of the specific products used.

G. If the submittal deviates from the requirements of the specifications in any way, it shall be clearly marked in the submittal with the justifying reason stated for evaluation by Engineer.

H. Electrical and control submittals shall include a verbal description of the functions, metering equipment, alarm points, alarm sequences, and any other specific features provided.

I. Electric motor submittals shall be in accordance with Section 15170, Motors.

J. Electrical equipment submittals shall be in accordance with Division 16, Electrical Specifications.

K. Control panel submittals shall be in accordance with Division 17, Instrumentation Specifications.

L. Engineer's review of the Contractor's shop drawings shall in no way relieve the Contractor of any of his responsibilities under the contract. The Engineer's review will be confined to general arrangement and compliance with the Contract Documents only, and will not be for the purpose of checking dimensions, weights, clearances, fitting, tolerances, interferences, coordination of trades, etc.

M. The review of shop drawings submitted by the Contractor shall not constitute a waiver of any of the requirements of this contract, nor shall the Owner be compelled to accept any structure, equipment or apparatus unless it passes all the tests and requirements of the Contract Documents.

1.07. SAMPLES

A. Provide in accordance with this section and as required by individual specification sections.

B. Submit samples to illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

C. Submit samples of finishes from the full range of manufacturers' standard colors in custom colors selected, textures, and patterns for Engineer's selection.

D. Include identification on each sample, with full project information.

E. Submit the number or samples specified in individual specification sections; one of which will be retained by Engineer.

F. Reviewed samples which may be used in the work are indicated in individual specification sections.

1.08. MANUFACTURER'S INSTRUCTIONS

A. When specified in individual specification sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing, in quantities specified for product data.

B. When specified in Section 01640, Equipment-General, submit manufacturer's operation and maintenance instructions for equipment supplied for this project. Manuals shall be delivered after shop drawing approval and prior to equipment being started up, and shall be prepared in accordance with Section 01640, Equipment-General.

C. Identify conflicts between manufacturers' instructions and Contract Documents.

1.10. MANUFACTURER'S CERTIFICATES

A. When specified in individual specification sections, submit manufacturer's certificate to Engineer for review, in quantities specified for product data.

B. Indicate that material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or product, but must be acceptable to Engineer.

D. When specified in Section 01640 or individual specification sections, submit manufacturer's Performance Affidavit for equipment to be furnished for this project. Affidavits shall be of format and content prescribed in Section 01640, Equipment-General, and shall be included with the shop drawing or product data submittal for the item of equipment to be furnished.

E. Provide certifications that the iron and steel products and/or materials used on this project are in full compliance with American Iron and Steel (AIS) requirements in accordance with the provisions of the Consolidated Appropriations Act. Certifications shall include:

1. Name of manufacturer.

2. Location of manufacturing facility where the product or process took place (not its headquarters).

3. A description of the product or item being delivered.

4. A signature by a manufacturer's responsible party.

Refer to the NYS SRF Bid Packet included as an Exhibit to the Agreement.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01320

PHOTOGRAPHIC DOCUMENTATION

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Construction photographs.

1.02. DESCRIPTION

A. Take construction record photographs prior to mobilization and daily during the course of the work.

B. Contractor shall provide construction documentation as specified in this section unless otherwise noted.

1.03. CONSTRUCTION PHOTOGRAPHS

A. Contractor shall provide digital construction photographs taken prior to construction and daily during construction as listed below and shall be furnished to Engineer and Owner on a monthly basis with each Application for Payment.

1. Before mobilization.

a. A minimum of 150 digital photographs of the pre-construction conditions shall be provided. Photos shall be taken in the following locations:

1) On each level within the existing pump station.

2) Within the wetwells.

3) The effluent channel area of the screen building.

4) The grounds area west of the existing wetwells.

5) The proposed staging area east of the Tallman wetwells and west of the Union Hill wetwells.

6) The potential bypass pump route.

7) The manholes where the bypass pumps are proposed to discharge.

8) The air relief and cleanout valve locations

9) Bypass piping for the air relief and cleanout manholes

2. Weekly progress photos of each work area.

3. Completion of underground facilities prior to backfilling.

4. Completion of installation of bypass pumping system.

5. Installation of all interior and exposed exterior piping, equipment, and electrical components.

6. Testing of all piping, equipment, and systems.

7. Completion of work at each work area.

8. Completion of site restoration and landscaping.

B. Views and quantities required:

1. At least 20 photos per week of each work area.

2. Multiple views of each item and conditions before any element of the work is buried/covered.

C. Camera used for digital photography shall be a 10.0 megapixel or greater.

D. Electronic Copies

1. Maintain database of pictures for the entire duration of the project.

2. Each month provide duplicate flash drives or portable hard drive with electronic versions of all prints taken in the past month (in .jpeg format).

3. Provide duplicate flash drives with electronic versions of all prints taken in during the course of the Project (in .jpg format) with final Application for Payment.

4. All electronic copies of photos shall be in .jpg format. All electronic copies of photos shall be arranged on flash drives by date and subject. Each .jpg photo file name shall include the subject description and date (example, YYYYMMDD – Description).

5. All electronic copies of the photos shall include the following identification:

a. Name and Owner's Contract number.

b. Location, subject and orientation of view (for example, "Smith Road, Station 3 + 45, pipe installation, looking north").

c. Date and time of exposure.

1.04. REUSE OF CONSTRUCTION DOCUMENTATION

A. All construction documentation furnished to Owner shall become the property of the Owner and cannot be copyright or otherwise protected in a manner that prevents free reuse by either the Owner and/or Engineer.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01. DELIVERY OF PRINTS AND ELECTRONIC COPIES

A. Preconstruction photos shall be provided no later than 7 days before the start of any onsite work.

B. Monthly construction photos (in electronic format) shall accompany each monthly Application for Payment. Monthly Applications for Payment will not be approved without receipt of such materials.

C. Final construction photos shall accompany the final Application for Payment. This Application for Payment will not be approved without receipt of such materials.

D. Provide prints at the request of the Owner or Engineer.

END OF SECTION

SECTION 01500

TEMPORARY FACILITIES

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Continuity of service.

B. Temporary utilities.

C. Temporary controls.

D. Construction facilities.

1.02. CONTINUITY OF SERVICE

A. Provide temporary equipment including pumps, piping, valves, bulkheads, electrical equipment and all system components necessary to maintain the existing facilities in service during construction.

B. Provide temporary power, instrumentation, controls, and alarms necessary to assure continued facilities operation during the alterations of existing facilities components or installation of new equipment.

C. Maintain power, controls, and emergency backup power supply to all equipment and facilities determined by Owner to be essential to facilities operations, specifically those currently receiving power through the existing Union Hill Pump Station and Tallman Pump Station. Extend temporary power from stations or provide temporary electrical connections and/or emergency generator(s), if necessary.

D. Construction may require the closing of various gates and valves to isolate tanks, channels, and equipment. The Owner does not guarantee that the gates and valves will be completely watertight. It is the Contractor’s responsibility to take whatever measures are necessary to proceed with construction in the event that valves or gates leak or do not operate.

E. Provide temporary access required, including ladders, platforms, grating, walkways, and awaits which comply with OSHA laws, for necessary facilities operations.

F. Provide all line stops and temporary bypass piping and valves required to connect new piping to existing piping, unless otherwise specified.

G. No extra payment shall be made for any labor, materials, tools, equipment or temporary facilities required during construction. All costs therefore shall be considered to have been included in the Bid.

1.03. TEMPORARY ELECTRICITY

A. The existing electrical service and the equipment therein provides power for the following facilities:

1. Union Hill Pump Station

2. Tallman Pump Station

B. Provide temporary electrical service to the Union Hill and Tallman Pump Stations as the Contractor deems necessary to facilitate the work.

C. Provide temporary electrical service to maintain current and full operation of the Union Hill and Tallman Pump Stations. Contractor shall be prepared to provide a temporary electrical service of approximately minimum 400 amps for these facilities. The temporary electrical service shall also include temporary receptacles with ground fault protection, as required for construction purposes for all trades (ex: temporary power for hand tools, temporary lighting, etc.). The Contractor at their option may propose an alternate method of providing the required temporary power.

D. Temporary electrical equipment, including overcurrent protection devices, required to provide the temporary service shall be located within the fenced-in pump station site, or in an alternate location, as agreed upon with the Engineer and Owner. All required electrical work shall be installed by an electrical contractor licensed in Rockland County.

E. Contractor's power consumption shall not disrupt Owner's need for continuous service.

F. Owner will pay cost of electricity used by Contractor. Exercise measures to conserve energy. Owner reserves the right to charge for the cost of electricity if the General Contractor use of electricity is excessive or if the Contractor fails to complete the work within the contract time.

G. Contractor shall provide temporary electric feeders from existing building's electrical service(s) as necessary to complete the work. Power consumption shall not disrupt Owner's need for continuous service.

H. Contractor shall provide power outlets for construction operations, and those of other contractors, with branch wiring and distribution boxes located at each floor. Provide flexible power cords as required.

I. Contractor shall provide main service disconnects and overcurrent protection at convenient location as required.

J. Contractor shall provide adequate distribution equipment, wiring, and outlets to provide single phase branch circuits for power and lighting for Contractor operations.

1. Provide 20 ampere duplex outlets, single phase circuits for power tools for every 200 sq. ft. of active work area.

2. Provide 20 ampere, single phase branch circuits for lighting.

1.04. TEMPORARY LIGHTING

A. Contractor shall provide and maintain lighting for Contractor operations to achieve:

1. A minimum lighting level of 20-foot candles for construction operations for interior work areas.

2. A minimum lighting level of 1 foot candles lighting to exterior staging and storage areas after dark for security purposes.

3. A minimum lighting level of 1 foot candles lighting to interior work areas after dark for security purposes.

B. Contractor shall provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required, for Contractor's operations and those of other contractors.

C. Contractor shall maintain lighting and provide routine repairs.

D. Permanent building lighting may be utilized during construction.

1.05. TEMPORARY HEATING

A. Contractor shall provide temporary heating equipment as required to maintain specified conditions for Contractor's construction operations.

B. Owner will pay cost of energy used for heating. Exercise measures to conserve energy. Contractor shall provide temporary, insulated closures of all exterior openings to minimize heating losses.

C. Contractor shall maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress and 65 degrees F in plant personnel-occupied areas, unless indicated otherwise in individual specification sections.

1.06. TEMPORARY COOLING

A. Contractor shall provide cooling devices and cooling as needed to maintain specified conditions for Contractor's construction operations and those of the other contractors.

B. Prior to operation of permanent equipment for temporary cooling purposes, verify that installation is approved for operation, equipment is lubricated, and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.

C. Maintain maximum ambient temperature of 90 degrees F (26 degrees C) in areas where construction is in progress, unless indicated otherwise in specifications.

1.07. TEMPORARY VENTILATION

A. Contractor shall provide temporary ventilation equipment as required to maintain clean air for Contractor's construction operations.

B. Owner will pay cost of energy used for ventilation.

1.10. TEMPORARY WATER SERVICE

A. Contractor shall provide and maintain suitable quality water service required for Contractor's construction operations. Contractor is allowed to connect to Owner's existing water source. Provide backflow protection where needed.

B. Owner will pay cost of water used. Exercise measures to conserve water.

C. Contractor shall extend branch piping with outlets located so water is available by hoses with threaded connections. Contractor shall provide temporary pipe insulation to prevent freezing.

D. Contractor shall provide sufficient potable quality drinking water for its employees at the project site.

1.11. TEMPORARY SANITARY FACILITIES

A. Contractor shall provide and maintain required sanitary facilities and enclosures for use by all persons employed at the site. Provide at time of mobilization. Existing facilities shall not be used.

B. Contractor shall remove facilities from site at end of construction.

1.12. BARRIERS

A. Contractor shall provide barriers to prevent unauthorized entry to construction areas to allow for Owner's use of site, and to protect existing facilities and adjacent properties from damage from construction operations and demolition. Maintain Owner access to all areas of plant in continuous operation.

B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.

C. Provide protection for plant life designated to remain. Replace damaged plant life.

D. Protect vehicles, stored materials, site, and structures from damage.

E. Supplement barriers with suitable signs, railings and night lights, as necessary to conform with governing authorities and regulations.

1.13. WATER CONTROL

A. Contractor shall grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.

B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

1.14. EXTERIOR ENCLOSURES

A. Contractor shall provide temporary insulated weather-tight closure of exterior openings to accommodate acceptable working conditions and protection for products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.15. INTERIOR ENCLOSURES

A. Contractor shall provide temporary partitions and ceilings as required to separate work areas from Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.

B. Construction - Framing and plywood sheet materials with closedjoints and sealed edges at intersections with existing surfaces; insulated STC rating of 35 in accordance with ASTM E90.

C. Paint surfaces exposed to view from Owner-occupied areas.

1.16. PROTECTION OF INSTALLED WORK

A. Contractor shall protect their installed work from damage and deterioration due to construction activities, traffic, birds, pests, vermin, wildlife, pets, pedestrians, visitors, vandals, dust, vapors, floods, precipitation, driving rain, wind, snow storms, melting temperatures, or freezing temperatures; provide special protection where specified in individual specification sections.

B. Provide temporary and removable protection for installed products. Control activity in immediate work area to minimize damage.

C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

E. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

F. Prohibit traffic over landscaped areas. Provide adequate barriers, directional signs, and/or guards, if necessary, to provide adequate protection of landscaped areas.

G. Owner reserves right to order that additional protective measures be taken beyond those proposed by Contractors, to safeguard the existing facilities and Work at no additional cost to Owner.

1.17. SECURITY

A. Contractor shall provide security and facilities to protect its work, and that of other contractors including existing facilities, and Owner’s operations from unauthorized entry, vandalism, or theft.

B. Contractor shall maintain a daily sign-in sheet for his workers and subcontractors.

1.18. ACCESS ROADS

A. Contractor shall utilize existing on-site roads for project access and construction traffic. Coordinate with Owner and Engineer.

1. Provide detours as necessary for unimpeded traffic flow.

2. Roads shall be free for use by all personnel involved in project and be adequate for transportation of persons, materials, equipment, and products to construction area.

3. Maintain roads in serviceable condition, free of obstructions, potholes, ponded water, debris, and accumulated snow and ice, until completion of project.

1.19. PARKING

A. Staging areas have been identified on the Contract Drawings for Contractor’s use. When site space is not adequate, Contractor shall provide additional off-site parking for their employees.

1.20. MAINTENANCE OF TRAFFIC

A. Contractor shall maintain and regulate traffic within Contract Limits and on public roads due to deliveries in accordance with applicable state, county, and local regulations.

B. Conduct operations so as to maintain access for vehicular and pedestrian traffic to and from properties adjoining or adjacent to those streets and roads at the treatment plant affected by construction activities, and to subject the public to a minimum of delay and inconvenience.

C. Provide flagmen as necessary to maintain and regulate traffic.

D. Provide flagmen, to direct and regulate traffic on roads on which traffic will be subject to delays or detours caused by construction operations.

E. Plan operations so that access to any site building is assured in case of fire or other emergency.

F. Contractor shall comply with requirements of Department of Transportation agencies having jurisdiction.

1.21. PROGRESS CLEANING

A. Contractor shall maintain areas free of waste materials, debris, and rubbish. Maintain site and structures in a clean and orderly condition, as follows:

1. Remove debris and rubbish from pipe chases, plenums, attics, crawlspaces, and other closed or remote spaces, prior to enclosing the space.

2. Broom and vacuum clean interior areas prior to start of surface finishing and continue cleaning to eliminate dust.

3. Collect and remove waste materials, debris, and rubbish from site weekly and dispose offsite.

B. Contractor shall store unused tools and equipment at its yard or base of operations.

1.22. POLLUTION CONTROLS

A. Dust Control

1. Contractor shall execute work by methods to minimize raising dust from construction operations.

2. Provide positive means to prevent airborne dust from dispersing into atmosphere.

3. Wash down disturbed areas daily.

4. Implement best management practices in accordance with requirements of agencies have jurisdiction over dust control.

B. Erosion and sediment control shall be provided in accordance with the Contract Documents and the requirements of governing regulatory agencies.

1. Contractor shall plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas.

2. Minimize amount of bare soil exposed at one time.

3. Provide temporary measures such as berms, dikes, and drains, to regulate water flow and prevent soil erosion.

4. Periodically inspect earthwork in disturbed areas to detect evidence of erosion and sedimentation; promptly apply corrective measures.

5. Implement best management practices in accordance with requirements of agencies have jurisdiction over erosion and sediment control.

C. Noise Control

1. All construction equipment and tools exhibiting potential noise nuisance shall be provided with noise muffling devices.

2. Confine use of such equipment and tools between the hours of 7 a.m. and 5 p.m.

3. Implement best management practices in accordance with requirements of agencies having jurisdiction over noise control.

D. Pollutants Control - Provide methods, means and facilities to prevent contamination of soil, water and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.

1.23. PROJECT IDENTIFICATION

A. Contractor shall provide project sign as required by funding agency and in accordance with the Contract requirements.

B. Erect on site at location established by Engineer/Owner.

C. No other signs are allowed without Owner permission except those required by law or specified elsewhere in the Contract Documents.

1.24. REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, controls, materials, prior to Substantial Completion.

B. Remove temporary barriers, enclosures, etc. in concert with completion of those segments of work which no longer require such measures.

C. Remove temporary underground installations to a minimum depth of 2 feet.

D. Clean and repair damage caused by installation or use of temporary work.

E. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

1.25. CONTRACTOR’S FIELD OFFICE

A. Provide weathertight field office with lighting, electrical outlets, heating, cooling and ventilating equipment, and equipped with sturdy furniture, drawing rack, drawing display table, and filing cabinets for Contractor’s use.

B. Provide space for project meetings, with table and chairs to accommodate 10 persons.

C. The location of office trailers is to be approved by the Owner and Engineer.

D. In addition to a field office, the Contractor shall at all times possess a cellular telephone.

E. Readily accessible copies of both the Contract Documents and the latest approved working drawings shall be kept in the field office by the Contractor at all times.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01540

TEMPORARY BYPASS SYSTEMS

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Mobilization and demobilization.

B. Nature and capacity of system to be bypassed.

C. Flow bypass plan requirements.

D. Air release valve and cleanout bypass

E. Backup and standby equipment requirements.

F. Installation, operation, and removal of facilities.

G. Sound attenuation.

1.02. DEFINITIONS

A. Bypass Pumping System - The bypass pumping system shall consist of all equipment, pumps, piping, valves, meters, plugs, line stops, power supplies, and other appurtenances required to divert sewer flows upstream of the existing pump stations and both upstream and downstream of air release/cleanout manholes as shown in Contract Drawings and indicated in paragraph 1.04.A. The bypass pumping system shall be comprised of the required number of pumps to meet the system requirements in addition to the bypass piping system necessary to deliver the flow to the discharge points as needed to complete the work. The work shall be scheduled in such a manner that allows the completion of the work in a time frame that minimizes the duration of bypass pumping.

B. Bypass Piping - The bypass piping shall consist of the piping, valves, supports, and other appurtenances including, but not limited to, meters, line stops, air relief valves and dewatering connections. The bypass piping includes both the suction and discharge piping for each primary and backup pump bypass setups, and bypass piping for manholes. Separate suction pipes shall be provided for each bypass pump.

C. Forcemain Bypass – The forcemain bypass shall consist of above ground piping, pipe restraint system, line stops, valves, and other appurtenances including, but not limited to air relief valves and dewatering connections. The forcemain bypass shall isolate the forcemain to depressurize and drain, to allow for the replacement of air relief valves, clean outs, and the necessary fittings. The work shall be scheduled in such a manner that allows the completion of the work in a time frame that minimizes disruption to wastewater conveyances.

1.03. PERFORMANCE REQUIREMENTS

A. It is essential to the operation of the existing sewerage system that there be no interruption or frequent changes in the flow of sewage throughout the duration of the project. Planned changes in flow rates must be prior coordinated with the Owner. The system shall not be allowed to be put into operation until all pumps, piping, and valves, control panels, VFD’s,

MPDS and MCC's and other electrical components required for the new work and new pump operation are on site and ready for installation.

B. The Contractor shall provide, maintain, and operate all temporary facilities such as dams, plugs, pumping equipment, conduits, all necessary power, and all other labor and equipment necessary to intercept the sewage flow before it reaches the point where it would interfere with work; carry it past this work; and return it to the existing conveyance system downstream of the work.

C. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

D. The Contractor shall incorporate provisions to remove water from the primary bypass pumping system to protect against freezing and damage. During cold weather operations, diesel generators shall utilize trickle chargers and block heaters, and critical priming piping shall be protected with heat tracing. Contractor shall provide cold weather mix diesel fuel during cold weather operations.

1.04. BYPASS PUMPING SYSTEM DESCRIPTION

A. Design Responsibility and Vendor Qualifications- The design, installation and operation of temporary bypass systems shall be the Contractor's responsibility and shall be designed by an Engineer licensed in NY State. Contractor shall employ the services of a Professional Engineer and vendor who can demonstrate to the Engineer that they specialize in the design and operation of temporary bypass systems. The Professional Engineer and vendor shall provide at least five references of projects of similar size and complexity as this project performed within the past five years. The temporary pumping system shall be in accordance with laws and regulations, including local noise and light ordinances.

B. Fuel Supply- Provide fuel supply for 48 hours of operation on site for diesel-powered systems, stored in accordance with laws and regulations. Assume responsibility for all spills and regulatory fines due to failure of the temporary pumping system.

C. System Capacity- Designed to pump peak required influent flow of 8 mgd. Average daily flow is approximately 1.3 mgd for both pump stations. Minimum expected flow is 0 mgd.

D. Suction Location – The Contractor shall intercept the influent forcemains prior to entering the stations. This could include tapping the forcemain with a direct connection to the bypass pumps or installing a doghouse manhole with the capacity to act as a temporary wet well. For Union Hill Pump Station, the gravity sewer will also need to be intercepted prior to entering the building. The effluent connection in the manhole located immediately outside of the pump station can be plugged and flow can either be diverted to the forcemain doghouse manhole or be pumped separately. It may be necessary to provide a grinder pump for the gravity flow as it will be unscreened. For Tallman Pump Station, the gravity sewer can be pumped from the grinder chamber located at the northeast corner of the site. The discharge of this chamber will be plugged during bypass pumping.

E. Discharge Location – Primary discharge point for the bypassed flow shall be to the existing bypass connection at Union Hill Pump Station and to the new bypass connection at Tallman Pump Station. Piping discharge lines shall include appurtenances to minimize the amount of splashing of wastewater outside the channel. Contractor also responsible to provide a means to prevent backflow from the bypass line back to the pump stations during the bypassing operation. Means may include sewer plugs, sandbags, steel plating, etc.

Contractor shall submit for approval all bypass pumping pipe location from suction location to discharge location. Contractor shall provide access to all structures. Contractor shall provide protection to the bypass pipe.

Refer to site layout in Contract Drawings for bypass pump lay down area and influent sewer suction layouts.

F. Elevations

1. Union Hill Pump Station first floor – 371 ft

2. Tallman Pump Station first floor – 484 ft

The above elevations are approximate. The Contractor is required to verify elevations prior to preparing the bypass pumping system design and submittal of shop drawings.

G. Monitoring – Suction well levels shall be continuously monitored using level sensing instrumentation. For each suction location, provide redundant level measuring devices. Provide either of the following two methods for monitoring of the bypass pumping system:

1. Provide representative of the Contractor trained and certified by the pump supplier to continuously monitor the system, on site, 24 hours per day, 7 days per week during operation. Notify Owner immediately in the event of a pump and/or system failure. The installed backup pump shall be connected to the control systems and begin operating immediately upon failure of the primary pump.

   Contractor shall also provide auto dialer or other means to communicate levels and alarms via text and phone call to Contractor and Owner. A local audible alarm at the suction location adjacent to the pumps shall also be provided in the event of an alarm condition.

2. Install, test, and maintain remote telemetry to monitor operation of the temporary bypass pump(s) and the suction well level(s). system shall notify Contractor and Owner within immediately of a pump and/or system failure. Contractor personnel shall report to site within 30 minutes of a pump and/or system failure. The installed backup pump shall be connected to the control systems and begin operating immediately upon failure of the primary pump.

   Contractor shall also provide auto dialer or other means to communicate levels and alarms via text and phone call to Contractor and Owner. A local audible alarm at the suction location adjacent to the pumps shall also be provided in the event of an alarm condition.

H. Sound Attenuation- Temporary pumping systems shall be equipped with sound attenuation features that limit the noise output to 69 dbA within 30 feet of the equipment, or to 60 dbA at the nearest residence or the property line, whichever is less.

I. Provide variable frequency drives to meet variable flow demands and temporary pumping requirements.

J. See Section 01010, Summary of Work, for facility outage requirements and constraints.

K. Pumps

1. The pumps and drives shall be rated for continuous duty and shall be capable of pumping the required flow ranges without surging, cavitation, or vibration. Where required pumping rates are not specified, coordinate with Engineer to determine required pumping range prior to submitting associated shop drawings. Pumps shall not overload drivers at any point on the pump operating curve. Pumps shall be suitable for use with raw unscreened wastewater and trash consistent with current influent wastewater flow into the treatment plant. Pumps shall be self-contained units designed for temporary use.

2. Pumps shall either have fully automatic self-priming units that do not require the use of foot-valves or vacuum pumps in the priming system, or they shall be submersible.

3. The pumps shall be electric, diesel powered, or powered by a diesel-powered generator.

L. The system shall include, at a minimum, the following equipment:

1. One primary pump. The primary pump shall be capable of pumping the average day flow of 1.3 mgd, be connected to the bypass piping, be isolated with valves, and be complete with power supplies.

2. One installed backup pump with equal capacity of primary (largest) pump. Backup pump shall be connected to the bypass piping, be isolated with valves, and be complete with power supplies.

3. Secondary pumps as required to provide the overall system capacity specified. All secondary pumps shall be connected to the bypass piping, be isolated with valves, and be complete with power supplies.

4. Required pump control panels, variable speed drives, instrumentation and float switches, and other equipment for pump operations and alarm indication.

M. For electric driven pumps, provide temporary portable generator adjacent to bypass pumps at suction location. Generator shall be capable of powering all pumps necessary to meet peak flow. In addition, Contractor shall provide an additional standby generator in the event the primary generator fails.

N. Provide temporary chain link fencing around all locations where temporary bypass pumps, piping, and other accessories are located in roadways, driveways, and other vehicle-accessed areas.

O. System shall be as provided by Godwin Pumps, or approved equal.

1.05. BYPASS DISCHARGE PIPING AND METER

A. Provide discharge piping from bypass pump location to the bypass connection.

B. Discharge points shall be valved to allow throttling for flow adjustments.

C. Meter - Provide meter(s) on bypass pumping system main discharge header(s) to measure and record all flow pumped through the temporary bypass pumping system. Meter shall be magnetic type. Metering system shall measure instantaneous and total flow on a daily basis and be capable of providing trending data. Flow information shall be continuously monitored and recorded.

1.06. SUBMITTALS

A. Provide product data describing conformance to ASTM and ANSI codes of the bypass pipe material.

B. The Contractor will retain the services of a licensed New York State engineer to design, review the installation, and approve the bypass pumping and piping system, and for the temporary electrical system (if electric driven pumps are selected). Calculations and review comments will be kept on file throughout the duration of the contract.

C. Flow Bypass Plan

1. The Contractor shall submit to the Engineer plans and descriptions pertaining to the bypass pumping provisions to be taken by the Contractor regarding the handling of peak flows at least 60 days prior to its intended use. System installation shall not begin until all submittals have been reviewed by the Engineer and are determined to be complete.

2. The plan shall include, but not be limited to, details of the following:

a. Material and locations of suction piping installation.

b. Material, locations and diameters of discharge piping installation and associated valves, meter and pipe supports.

c. Locations and number of each bypass pump and power requirements. System shall be confined to the potential locations on site as identified on the Contract Drawings. Actual configuration of system area may be modified to allow Owner suitable access to site facilities.

d. Compliance with permits required by the New York State Department of Environmental Conservation or the Owner.

e. Plan for sound attenuation for each pump and/or generator.

f. Cold weather operational plan and equipment design to protect equipment and pipes from freezing, including provisions to remove water that is trapped in sections at low spots in the discharge line.

g. Standard and emergency shutdown plan indicating emergency (24-hour) contacts, drain points, drain down time, disinfection and disassembly.

h. Schedule for installation of and maintenance of bypass pumping lines.

i. Details for personnel crossings.

j. Proposed controls approach with respect to pump speed changes, start and stop levels, and alarm elevations.

k. Monitoring and alarm system(s) that will provide immediate determination of loss of bypass pumping integrity during operation.

l. Schedule for routine inspection of bypass pumping lines.

m. Temporary electrical cabling, equipment and system for electric driven pumps.

n. Spill containment plan.

3. The Engineer's and Owner's receipt of flow bypass plan does not relieve Contractor of responsibility for means, methods, and sequences of construction, requirement to pump and transport peak flows, and for safety.

1.07. PROJECT RECORDS

A. The Contractor shall maintain records which indicate the following:

1. Dates of installation and operation of primary and secondary setups.

2. Maintenance schedules for each pump.

3. Dates and times of any failures or flow loss from the bypass pumping system.

4. Dates and times of any backups of flow and Contractor action with corrective actions taken.

1.08. REGULATORY REQUIREMENTS

A. Conform to regulatory agencies having jurisdiction over the work.

B. Contractor is responsible for fines levied on Owner by state, federal, and/or other agencies due to spills caused by failure of temporary pumping and piping systems.

1.09. FIELD MEASUREMENTS

A. Prior to start of construction, verify by field measurements that existing conditions and elevations are as shown on Drawings or noted herein. Notify Engineer of differences.

1.10. COORDINATION

A. Coordinate field work under provisions of-General Contract Conditions, including maintenance of traffic and emergency 911 service.

B. Coordinate work with local utility companies (private and municipal) for location of existing utilities and protection thereof.

C. Coordinate flow bypassing with Owner. The Contractor will be responsible for the removal or moving of snow surrounding the bypass system and piping.

1.11. SCHEDULING

A. The Contractor shall be responsible for the installation, operation, and removal of all flow bypass facilities and surface restoration in accordance with the contract and the approved project schedule.

B. After Owner and Engineer review and approval of temporary pumping system submittal(s), and at least 14 days prior to intended use, schedule a coordination meeting with the Owner, Engineer, Contractor, and subcontractor or temporary pump supplier, if applicable.

C. No demolition or temporary bypass pumping shall take place until all new piping, valves, and pumps, control panels and MCC's and other electrical equipment necessary for pump operation for the Union Hill Pump Station upgrade work and the Tallman Pump Station upgrade work has been delivered to the site.

D. No bypass pumping shall occur until after satisfactory completion of the coordination meeting and until all required components of the bypass pumping system are on site and installed including, but not limited to, pumps, piping, valves, bends, meters, instrumentation, generators, and supports.

E. Work shall be scheduled to minimize the duration of bypass pumping.

PART 2 PRODUCTS

2.01. MATERIALS - BYPASS PIPING

A. Flexible Piping - Synthetic rubber core, reinforced with synthetic fabric with wire helix, covered with synthetic rubber wrapping. Joint fittings to match rigid piping fittings.

B. High Density Polyethylene (HDPE) Pipe - Pipe shall be HDPE PE 4710 and meet ASTM C3350, ASTM D1505, ASTM D1238. Pipe shall be minimum DR-11, 200 psi working pressure. Pipe shall be manufactured by J-M Manufacturing Company, or equal.

C. Fittings shall be HDPE anchor fittings, butt fusion welded to pipe. Fittings shall include stainless steel stiffener, insert, and all other accessories required. Pipe and anchor fitting shall be the same size.

2.02. EQUIPMENT

A. All pumps used shall be fully automatic self-priming units that do not require the use of foot valves or vacuum pumps in the priming system or be submersible type. All pumps must be constructed to allow dry running for long periods of time to accommodate the cyclical nature of sewer discharges.

B. The Contractor shall provide the necessary VFDs and stop/start controls for each pump.

C. Sewer plugs shall be water filled and pressurized and shall be capable of accommodating the maximum allowable surcharge heads that may be experienced during the construction of this project. The plugs shall also be readily removed from the system during emergency shutdown of the system. All plugs shall be firmly attached to a stationary object at ground level by a steel cable in order to prevent loss of plugs in pipelines.

D. Contractor shall provide necessary protection for bypass pumping equipment from freezing during cold weather operation. Pumps and/or generators shall include trickle chargers and block heaters, at minimum.

E. Contractor's spill containment plan shall provide necessary methods and materials to provide for containment of raw sewage, oil or other fluids from pump priming operations or routine maintenance. Contractor responsible for cleanup and disposal of any raw sewage or other fluids that spills onto the ground.

PART 3 EXECUTION

3.01. GENERAL

A. Install, operate, and maintain Bypass Pumping System and appurtenances, including but not limited to, associated piping, valves, instrumentation, controls, and accessories, in accordance with the manufacturer's instructions. Provide all oil, fuel, grease, lubricants, tools, and spare parts required for the operation and maintenance of the Bypass Pumping System for the duration of use. Remover all Bypass Pumping System and appurtenances equipment following the completion of temporary pumping.

B. Contractor is responsible for proper operation of complete Bypass Pumping System.

C. Adequate hoisting equipment for each pump and accessory shall be maintained on the Site.

D. Provide hay bales and tarping systems to enclose all exterior pumps and engines to further reduce noise levels, if required.

E. Demonstrate all Bypass Pumping System to Owner and/or Engineer for conformancewith the Contract Documents prior to use. Measure the noise output during the demonstration phase and provide the results to Engineer.

F. Bypass Pumping System shall be placed in service a minimum of 72 hours beforeany work requiring use of the Bypass Pumping System may begin. Demonstrate continuous trouble-free operation for entire 72-hour period.

G. Bypass Pumping System shall remain operable until all components of new work requiring Bypass Pumping Systems have successfully completed all required testing, startup and training and are accepted by the Owner. Once activated, do not decommission the Bypass Pumping System without prior approval of the Owner and Engineer.

H. Once written permission is issued by the Engineer, remove all components of the temporary pumping and piping systems. After removal of Bypass Pumping Systems, perform all restoration work to the satisfaction of the Owner.

I. Take precautions to prevent spills when cutting pipelines or decommissioning existing piping.

3.02. FIELD QUALITY CONTROL AND MAINTENANCE

A. Testing on Installation - The Contractor shall perform leakage and pressure tests of the bypass piping, using clean water, prior to actual operation if directed bythe Engineer. The test pressures shall be 1.5 times the expected operating pressures. The Engineer will be given 24 hours’ notice prior to testing.

B. Routine Inspection and Maintenance

1. The Contractor shall inspect all operating bypass pumping systems each weekdayor more frequently as necessary to ensure the proper operation of the system. Suction and discharge piping shall be cleaned to maintain the required performance of the bypass pumping system.

2. The Contractor shall ensure that the bypass pumping system is properly maintained.

C. Extra Materials

1. Spare parts for pumps and piping shall be kept on site as required.

2. Adequate hoisting equipment for each pump and accessories shall be maintained on the site.

3.03. PREPARATION

A. Precautions

1. The Contractor is responsible for locating existing utilities in the area selected for installation of the bypass pipelines. The Contractor shall minimize the disturbance and access to existing utilities and shall obtain approval from the Owner and Engineer for any relocation of the bypass pipeline. All costs associated with the relocation of utilities, if required, and obtaining of approvals shall be paid by the Contractor.

2. During all bypass pumping operations, the Contractor shall protect the bypass pumping and piping facilities from damage inflicted by equipment. The Contractor shall be responsible for all intentional or accidental physical damage to the bypass pumping and piping system caused by human or mechanical failure or interference.

3. During installation of the bypass pumping lines, the Contractor shall make every effort to minimize the disruption of work and travel at the treatment plant. The Contractor shall protect all structures or other obstacles in the path of the pipeline from damage through the use of shields and buffering devices. Temporary walkways for movement of Owner personnel across the site may need to be constructed.

4. Preconstruction photos and videotapes shall be produced by the Contractor to document the preconstruction condition of the pump installation area and pipeline route.

END OF SECTION

SECTION 01564

EROSION CONTROL

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Installation of sedimentation and erosion control barriers.

B. Anchoring all topsoil stockpiles with straw mulch and ringing with haybales.

C. Protection of catch basins with haybale or silt fence rings.

D. Inspection of all erosion measures after each rainfall and at least daily during prolonged rainfall.

E. Repairing immediately any failed sedimentation and erosion control barrier.

F. Removing and disposing sediment deposits in a manner that does not result in additional erosion or pollution.

G. Removal of haybales or silt fences after completion of construction and permanent stabilization of erosion.

H. Removal of sedimentation barriers after completion of construction.

1.02. PERFORMANCE REQUIREMENTS

A. Observe government policy established by United States Environmental Protection Agency (USEPA) Memorandum 78-1.

B. Observe requirements set forth by the Federal Highway Administration Task Force 25.

C. Conform all erosion and sedimentation control measures of “New York Guidelines for Urban Erosion and Sediment Control” published by USDA Soil Conservation Service.

1.03. PLAN

A. Taking into account specific constraints or other criteria outlined herein, the Contractor shall prepare a detailed plan which sets forth his program of operations to effectively control erosion and sediment-runoff at all times during construction and during the one-year guarantee period following completion of the work.

1. Two copies of the plan shall be filed with the Engineer.

2. At least one copy shall be kept at the project site at all times, and shall be made available for examination by authorized representatives of the regulatory agencies having jurisdiction over the project.

3. The plan shall be arranged so as to include:

a. Chronological completion dates for each temporary (and permanent) measure for controlling erosion and sediment.

b. Location, type and purpose for each temporary measure to be undertaken.

c. Dates when those temporary measures will be removed.

4. The plan shall be submitted within 10 days after the Notice to Proceed.

5. Submit in accordance with Section 01300, Submittals.

PART 2 MATERIAL AND PRODUCTS

2.01. MATERIALS

A. Hay/Straw Bales - Shall be securely tied and measure 14 inches by 18 inches by 30 inches long or greater.

B. Silt Fence

1. Super Silt Fence – As manufactured by Geofabrics or equal.

2. Silt fence shall include wire mesh and be constructed using fence posts and wire fence or prefabricated units in accordance with New York guidelines for urban erosion and sediment control.

C. Stakes and Fasteners

1. Shall be two #3 rebar or two 2-inch by 2-inch minimum hardwood stakes for each hay/straw bale.

2. Shall be a minimum of 2-inch by 2-inch minimum by 48-inch hardwood post for silt fences.

D. Erosion Control Fabric - North American Green Type S75 or equal shall be used.

2.02. PRODUCTS

A. Sediment Barriers - Sediment barriers shall be hay or straw bales, stone, silt fences or other approved materials that will prevent migration of silts and sediment to receiving waters.

B. Mulch and Seeding - Mulch and seeding shall be in accordance with requirements of Tables 1 and 2 of this section.

C. Diversion Terraces - Diversion terraces shall be installed on the uphill side of the disturbed areas to divert surface runoff away from unstabilized slopes.

D. Interceptor Channels - Interceptor channels shall be installed across disturbed areas where the slope is running parallel to the direction of trenches.

E. Trench Barriers - Trench barriers shall be used where the disturbed area is sloped in direction of the pipeline, when the slope exceeds 15 percent.

F. Stabilized Construction Entrances – Stabilized construction entrances shall be installed at each work vehicle entry point.

G. Geotextile Dewatering Bag – Geotextile dewatering bags are to be used to trap sediment from dewatering activities.

PART 3 EXECUTION

3.01. GENERAL REQUIREMENTS

A. General Drawings do not show all of the necessary control measures to prevent erosion and sedimentation.

1. It is the Contractor's responsibility to design, implement and maintain erosion and sedimentation control measures which effectively prevent accelerated erosion and sedimentation.

B. All erosion and sedimentation control measures shall be inspected by the Contractor daily and immediately after periods of rainfall.

1. Repair and/or maintenance of sedimentation and erosion control measures will be made as soon as needed.

2. The Contractor will be held responsible for the implementation and maintenance of all control measures on this site.

C. Land disturbance shall be kept to a minimum.

1. Restabilization will be scheduled immediately after any disturbance.

D. Silt fences or haybales will be installed along the toe of all critical cut and fill slopes.

E. Catch basins will be protected with silt fences or haybales throughout the construction sequence and until all disturbed areas are stabilized.

F. Erosion and sedimentation control measures will be installed prior to all construction activities.

G. Sediment removal from control structures shall be the responsibility of the Contractor.

1. Sediment shall be disposed of in a manner which is consistent with overall intent of plan and which does not result in additional erosion.

H. The erosion and sedimentation control measures described herein are intended as a general guide for the Contractor.

1. It is the Contractor's responsibility to provide any and all work necessary to prevent erosion of soil from the construction site and to provide silt fences, haybales or other control measures as the need arises during construction at no additional cost to the Owner.

I. Remove all sedimentation and erosion control barriers after completion of construction and permanent stabilization of erosion.

3.02. DIVERSION TERRACES

A. Diversion terraces shall be used as a temporary measure installed on the uphill side of the disturbed areas to divert surface runoff awayfrom unstabilized slopes, and the project area.

B. Recommended Minimum Dimensions

1. Height - 1.5 feet

2. Top Width - 2 feet

3. Side Slopes - 2:1 or flatter

4. Material - Soil

3.03. INTERCEPTOR CHANNELS

A. Interceptor channels shall be used across disturbed areas where the slope is running parallel to the direction of trenches.

B. Interceptor channels reduce erosion by intercepting storm runoff and diverting it to outlets on the lower side of the disturbed area where it can be disposed of having minimum erosion impact.

C. Recommended Dimensions and Materials

1. Depth - 0.5 feet

2. Width - 2 to 4 feet

3. Side Slopes - 2:1 or flatter

4. Spacing - Where required

5. Material - Stable on-site material

3.04. TRENCH BARRIERS

A. Trench barriers shall be used where the disturbed area is sloped in the direction of the pipeline, when the slope exceeds 15 percent.

B. Trench barriers shall be earth-filled sacks or piled stone, stacked to the top of the trench after installation of the sewer and prior to backfill, if backfill is delayed.

C. Trench barriers shall act as an erosion check by preventing the washout of the trench.

D. Recommended Dimensions and Materials

1. Height - To top of trench.

2. Spacing - Approximately every 150 feet.

3. Material - Earth-filled sacks or piled stones.

3.05. SEDIMENT BARRIERS

A. Sediment barriers shall be used at storm drain inlets; across minor swales and ditches; and at other applications where the structure is of a temporary nature and structural strength is not required.

1. Sediment barriers are temporary berms, diversions, or other barriers that are constructed to retain sediment on-site by retarding and filtering storm runoff.

B. Recommended Materials and Dimensions

1. Hay or Straw Bales

a. Bales should be bound with twine.

b. Bales should be anchored to the ground with fence posts, wood pickets, or #3 rebar. Two anchors per bale are required.

c. Bales shall be installed so that runoff cannot escape freely under the bales.

d. Height - 1.5 feet Width - 1.5 to 3.0 feet

e. Cross-Sectional Area Required Per Tributary Acre - 50 square feet

2. Stone

a. Height - 1.5 to 2.0 feet (uniform top elevation) top

b. Width - 3 to 5 feet

c. Side Slopes - 3:1 or flatter

d. Cross-Sectional Area Required Per Tributary Acre - 20 square feet

e. Material - Coarse rock or stone

3. Brush

a. Brush should be bound with twine.

b. Brush should be anchored such that it does not move and runoff cannot escape freely under the barrier.

c. Height - 1.5 to 2.0 feet

d. Cross-Sectional Area Required Per Tributary Acre - 15 square feet

4. Silt Fence

a. Synthetic wire mesh backed fabric 48 inches wide for fencing material.

b. Hardwood stakes shall be minimum 2-inch diameter spaced at 8 to 10 feet apart for posts.

c. Height - ±30 inches above ground.

3.06. MULCH

A. Used alone or in conjunction with other structural or vegetative erosion control measure, mulch is applied on any disturbed area which is subject to erosion, for protection of disturbed soil or newly reseeded areas.

3.07. EROSION CONTROL FABRIC

A. Erosion control fabric shall be used on slopes greater than 10 percent. Prior to installation of the erosion control fabric, the underlying layer is to be graded as shown on the Drawings.

3.08. VEGETATION

A. Temporary Vegetation

1. The planting of temporary vegetative cover shall be performed on disturbed areas where the earthmoving activities will be ceased for a period of more than 45 days.

a. The vegetation shall provide short-term rapid cover for the control of surface runoff and erosion, until permanent vegetation can be established or earthmoving activities can resume.

2. Table 2 gives recommended types of temporary vegetation, corresponding rates of applications, and planting seasons.

a. In situations where other cover is desired, the recommendations of the local and County Conservation Districts shall be followed.

B. Permanent Vegetation

1. Planting of various permanent vegetative covers shall be performed on disturbed areas where the earthmoving activities have ceased. The vegetation shall reestablish ground cover for the control of surface runoff and erosion.

2. The seed bed for permanent vegetative cover shall be prepared by using lime and fertilizer.

a. If the time of the seeding occurs during a dry period, mulch shall be applied to conserve soil moisture.

TABLE 1

MULCH MATERIALS, RATES AND USES

Mulch Material	Quality Standards	Application per 1,000 sq. ft.	Rates per Acre	Depths of Application
Straw or Hay	Air-Dried Free from Coarse	75-100 lbs. 2-3 bales	1.5-2.5 tons 90-120 bales	Lightly Cover 75 to 90% of surface
Wood Chips	Green or Air-Dried	500-900 lbs.	10-20 tons	2" - 7"

TABLE 2

TEMPORARY SEEDINGS FOR EROSION CONTROL OF CONSTRUCTION SITES

Species or Mixture for Temporary Cover	Percent by Weight	Seeding Rates in lbs. per 1,000 sq. ft.	Recommended Seeding Dates
Annual Rye Grass	100%	1	April 1 to June 1 and August 15 to October 15
Field Broomegrass	100%	1	March 1 to June 15 and August 15 to September 15
Sudangrass	100%	1	May 15 to August 15

3.09. SPECIAL CONDITIONS

A. Prohibited Construction Practices - Prohibited construction practices include but shall not be limited to the following:

1. Dumping of spoil material into any stream corridor, any wetlands, any surface waters or at unspecified locations, even with permission of the property owner.

2. Indiscriminate, arbitrary or capricious operation of equipment in any stream corridors, any wetlands or any surface waters.

3. Pumping of silt-laden water from trenches or other excavations into any surface waters, any stream corridors or any wetlands.

4. Damaging vegetation adjacent to or outside of the access road or the right-of-way.

5. Disposal of trees, brush and other debris in any stream corridors, any wetlands, any surface water or at unspecified locations.

6. Permanent or unspecified alteration of the flow line of the stream.

7. Open burning of construction project debris.

B. Defective Devices - Any erosion and sediment control devices which become damaged, clogged or otherwise non-functional shall be immediately replaced by the Contractor, without additional compensation.

C. Adjustment

1. If the planned measures do not result in effective control of erosion and sediment runoff to the satisfaction of the regulatory agencies having jurisdiction over the project, the Contractor shall immediately adjust his program and/or institute additional measures so as to eliminate excessive erosion and sediment-runoff.

2. If the Contractor fails or refuses to comply promptly, the Owner may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for excess costs or damages by the Contractor.

END OF SECTION

SECTION 01640

EQUIPMENT - GENERAL

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Submittals.

B. Performance affidavit.

C. Equipment design.

D. Spare parts.

E. Equipment identification.

F. Standardization of grease fittings.

G. Anchors and supports.

H. Shop tests.

I. Installation of equipment.

J. Testing.

K. Services of manufacturer's representative.

L. Operation and maintenance manual.

M. Lubrication schedule.

N. Failure of equipment to perform.

O. Guarantee.

P. Schedule of Equipment Testing and Manufacturer's Services.

1.02. SUBMITTALS

A. Submit shop drawings in accordance with General Contract Conditions.

B. Submit performance affidavits with applicable shop drawings. Submittals without required performance affidavits will be considered incomplete and will be returned not reviewed.

C. Installation Certificates.

D. Certification of Equipment Compliance.

E. Operations and maintenance manuals.

F. Training Plans

1. Submit no less than 30 days prior to proposed date for training in accordance with procedures identified in General Contract Conditions. and Section 01300, Submittals.

2. Training plan must be approved by Engineer prior to scheduling actual date for training.

3. Provide syllabus with sufficient detail to establish content of training, duration of each topic, and demonstrate adequate content to train Owner's staff on proper operation and maintenance of equipment.

G. DVD recordings of training sessions.

H. Written training reports.

I. Guarantees.

1.02. PERFORMANCE AFFIDAVITS

A. Provide performance affidavits for products listed in the Schedule of Equipment Testing and Manufacturer's Services, included at the end of this section and as required in the individual technical sections.

B. Performance affidavits shall be developed by each manufacturer and shall certify to Contractor and Owner, jointly, that manufacturer has examined the Contract Documents and that the equipment, apparatus, process, or system will meet the performance requirements and all specifications set forth in the Contract Documents in every way. Equipment design, manufacturing, and assembly specifications are an integral part of the performance requirements.

C. Shop drawings will not be reviewed prior to receipt by the Engineer of an acceptable performance affidavit.

D. The performance affidavit must be signed by an officer (vice president or higher) of the basic corporation, partnership or company manufacturing the equipment, and witnessed by a notary public.

E. The performance affidavits shall be in the following format:

Addressed to: (Contractor) and (Owner)

Reference: Contract No. (Project)

Text: "(manufacturer's name) has examined the Contract Documents and verified that the (product) meets in every way the performance requirements and design specifications set forth in Section(s) _____ of the Contract Documents."

Signature: Corporate officers shall be vice president or higher (unless statement authorizing signature is attached).

Notary: Signature(s) must be notarized.

1.03. EQUIPMENT DESIGN

A. Equipment and appurtenances shall be designed in conformity with ANSI, ASME, IEEE, NEMA, and other generally accepted applicable standards.

B. Equipment and appurtenances shall be of rugged construction and of sufficient strength to withstand all stresses which may occur during fabrication, testing, transportation, installation, all conditions of operation, or as required by specifications.

C. All bearings and moving parts shall be adequately protected by bushings or other approved means against wear, and provision shall be made for adequate lubrication by readily accessible devices.

D. Details shall be designed for appearance as well as utility. Protruding members, joints, corners, gear covers, etc., shall be finished in appearance. All exposed welds on machinery shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.

E. Machinery parts shall conform within allowable tolerances to the dimensions shown on the working drawings. The corresponding parts of identical machines shall be made interchangeable.

F. All machinery and equipment shall be safeguarded in accordance with the safety codes of the ANSI and OSHA and the State Industrial Code. All rotating shafts, couplings or other moving pieces of equipment shall be provided with suitable protective guards of sheet metal or wire mesh neatly and rigidly supported. Guards shall be removable as necessary to provide access for repairs.

G. Details promoting maintenance, ease of replacing parts, and lubrication shall be a prime consideration in design.

H. Products shall be designed for corrosion resistance and shall not be constructed of materials which may prohibit ease of maintenance due to corrosion. All fasteners on areas requiring access for maintenance and lubrication shall be Type 316 stainless steel unless otherwise specified. Zinc- or cadmium-plated fasteners for these areas shall not be used.

I. Iron and steel products used in this project shall be produced in the United States in accordance with AIS requirements. Refer to General and Supplemental Contract Conditions and Exhibit E for further requirements.

1.04. SPARE PARTS

A. Provide spare parts as required by individual specification sections.

B. Provide spare parts that are identical and interchangeable with original parts.

C. For each part (or group of small parts), provide a tag which shall carry the following information:

1. Name and associated tag number(s) of equipment.

2. Name of the part.

3. Manufacturer’s name and the date of manufacture.

4. Identification number of the part.

1.05. EQUIPMENT IDENTIFICATION

A. Each piece of equipment shall be provided with a substantial brass or stainless steel nameplate, securely fastened in a conspicuous place and clearly inscribed with the manufacturer's name, year of manufacture, serial number and principal rating data.

1.06. STANDARDIZATION OF GREASE FITTINGS

A. Provide grease fittings of the hydraulic type, Alemite #1600 Series, Lincoln, or approved equal.

B. Coordinate grease fittings on all mechanical equipment to be compatible with a single type of grease gun.

1.07. ANCHORS AND SUPPORTS

A. Obtain and install all necessary guides, bearing plates, anchor and attachment bolts, working drawings for installation, templates and all other appurtenances necessary for the installation of the equipment specified. Subcontractors furnishing equipment shall also furnish anchors and templates to the General Contractor.

B. Anchor bolts shall be of size and strength suitable for purpose intended and shall be in accordance with Section 05500, Miscellaneous Fabrications, and the individual specification sections.

C. Pipe sleeves or other means of adjusting anchor bolts shall be provided where indicated or needed. Equipment shall be leveled by first using sitting nuts on the anchor bolts and then filling the space between the equipment base and concrete pedestal with grout. Where equipment bases (i.e., pumps) are installed with grout holes, subsequent to field testing, those bases shall be totally filled with grout.

D. Provide grout as required by Section 03600, Grout.

E. Provide concrete equipment pads or housekeeping pads for all mechanical, heating and ventilating, plumbing and electrical equipment. Coordinate with other contractors before pad placement to confirm dimensions, location and anchor requirements.

1.10. SHOP TESTS

A. Arrange shop tests of the equipment indicated in the Schedule of Equipment Testing and Manufacturer's Services and individual equipment specification sections.

B. Arrange for the Engineer to witness performance tests in the manufacturer's shop, if required by the individual specification section.

C. Pump shop tests shall be conducted and reported in accordance with the Standards established by the Hydraulic Institute. Pump tolerances shall be within limits acceptable by these standards.

D. Demonstrate by the tests that the equipment characteristics, including any specified pressure, duty, capacity, rating, efficiency, performance, function or other special requirements, comply fully with the requirements of the Contract Documents and that it will operate in the manner specified.

E. Submit certified copies of the manufacturer's test data and interpreted results as required by Section 01300, Submittals.

1.11. INSTALLATION OF EQUIPMENT

A. Field modifications shall not be made without prior approval from Engineer.

B. Install all equipment strictly in accordance with recommendations of the manufacturer.

C. Provide all necessary guides, bearing plates, anchors, and attachment bolts, working drawings for installation, templates, and all other appurtenances necessary for the installation of the equipment specified.

D. Anchor bolts shall be of size and strength suitable for purpose intended and shall be in accordance with Section 05500, Miscellaneous Fabrications, and the individual specification sections.

E. Pipe sleeves or other means of adjusting anchor bolts shall be provided where indicated and where needed. Equipment shall be leveled by first using sitting nuts on the anchor bolts and then filling the space between the equipment base and concrete pedestal with grout. Where equipment bases (i.e., pumps) are installed with grout holes, those bases shall be totally filled with grout after successful completion of Functional Testing and prior to System Demonstration Testing.

F. Equipment pads shall be provided by the General Contractor. Coordinate with other Contractors before pad placement to confirm dimensions, location, and anchor requirements. Install any additional wiring and conduit systems required but not shown to be installed by the Electrical Contractor.

1.12. TESTING

A. Perform all testing in accordance with Section 01660, Testing and Startup.

1.13. SERVICE OF MANUFACTURER'S REPRESENTATIVE

A. Arrange for the equipment manufacturer to furnish the services of a qualified representative where specified in the Schedule of Manufacturer’s Services and the individual specification sections. The manufacturer’s representative shall visit the site as many times as needed to fulfill its obligations required by the Contract Documents. The minimum number of days required for manufacturer services is listed in the Schedule of Manufacturer’s Services. For equipment specified under Section 11306, Vertical Centrifugal Pumps, the qualified representative shall be a direct employee of the manufacturer (factory representative).

B. Contractor shall be responsible for any additional time required for the manufacturer’s representative to resolve equipment installation and/or operation problems due to a lack of coordination between the supplied equipment and the Contract Documents such as, but not limited to, dimensions, electrical problems or performance.

C. Arrange for the equipment representative to visit the plant on occasions after initial start-up and during the first year of operation, if required by the individual specification sections. The purpose of these visits shall be to review equipment operation, assist the operators in correcting operational problems and basic inspection of the equipment.

D. Manufacturer’s representative shall assist and supervise Contractor during installation, testing, and operation of equipment where specified in the Schedule of Manufacturer’s Services and the individual specification sections.

E. Manufacturer's representative shall provide all certificates specified in the Schedule of Manufacturer's Services and the individual specification sections.

1. Installation Certificate - Submit one copy to both Owner and Engineer of manufacturer representative's Installation Certificate indicating that the manufacturer's representative has inspected the installation and that the equipment provided by their organization has been properly installed, aligned, lubricated, and is ready for operation.

2. Certification of Equipment Compliance - Submit one copy to both Owner and Engineer of manufacturer representative's written Certification of Equipment Compliance indicating that the manufacturer's representative has witnessed the Functional Test for the equipment provided by their organization, final adjustments to the equipment have been made, the equipment has been tested to their satisfaction, and the equipment meets all performance and testing requirements included in the Contract Documents, excluding testing to be performed either during or after startup.

F. Testing Reports

1. Functional Test Reports - Submit one copy to both Owner and Engineer of manufacturer representative's written Functional Test reports including performance test results unless otherwise noted.

2. Performance Testing During or After Startup - When the Contract Documents require performance testing to be conducted during or after startup, submit one copy of performance test results with an updated Certification of Equipment Compliance as previously specified.

G. Training

1. Manufacturer shall provide services of qualified, factory trained, operations and maintenance personnel to instruct Owner personnel in proper care, operation, and maintenance of equipment. At a minimum, training shall include:

a. Theory of operation.

b. Actual operation.

c. Mechanical maintenance.

d. Electrical maintenance.

e. Instrumentation and alarms.

f. Optimization of operation.

g. Safe operating and working practices and operation of safety devices.

h. Troubleshooting.

i. Demonstration of equipment startup procedures, operation, and shutdown procedures using equipment installed under this contract.

2. Training shall be scheduled with the Owner. Training times shall be dependent on the availability of required Owner staff.

3. Trainer shall provide all materials and training manuals required for training in quantities required by Owner.

4. Contractor shall hire a professional video production firm to digitally record and produce video from all training sessions. All videos shall be clear in picture and sound quality and free from shake or vibration. Videos should be edited to include dates of training, subject matter, trainer's name and affiliation, and length of video on the title credits and shall be edited to remove any gaps from the program. Unacceptable training videos should be re-recorded and re-produced.

5. Provide one digital DVD recording of each training session to the Owner. DVDs and cases shall be labeled with project name, equipment description, date of training, trainer's name and affiliation.

6. Trainer shall develop a written report for each training session. At a minimum, reports shall summarize training sessions, indicate any problems that may have been encountered during operation of equipment, and include a sign-in sheet identifying all attendees. Contractor shall submit one copy of each training report to both Owner and Engineer.

H. Manufacturer or manufacturer's representative shall document equipment installation, checkout, startup, testing, and training on form, attached to this specification.

1.14. OPERATION & MAINTENANCE MANUALS

A. General

1. Submit operation and maintenance manuals as required by the Schedule of Manufacturer's Services and the individual specification sections in accordance with the procedures identified in General and Supplemental Contract Conditions. Manuals must be specific for the actual equipment installed on the project. Information on other equipment not applicable shall be deleted or crossed out.

2. Prior to completion of the work, and at least 30 days prior to the 50 percent payment, submit for Engineer's review three copies of all preliminary draft operation and maintenance manuals. Preliminary draft operations and maintenance manuals may be submitted separately for individual items.

3. Prior to completion of the work, and at least 60 days prior to the 85 percent payment, submit for Engineer's review three copies of all final draft operation and maintenance manuals. Preliminary draft operations and maintenance manuals may be submitted separately for individual items.

a. All comments generated by Engineer during review of preliminary draft operation and maintenance manuals must be adequately addressed prior to submission of final draft operation and maintenance manuals. Final draft operation and maintenance manuals shall be complete in their entirety except for specific information related to testing and startup. Final draft operations and maintenance manuals must be approved by Engineer prior to the following:

1) Training of associated items.

2) System Demonstration Testing.

4. Prior to final payment, provide three paper copies and one digital copy of the final operation and maintenance manual. The final operation and maintenance manual shall include all required operations and maintenance information consolidated into one manual with multiple volumes. The final operation and maintenance manual shall include testing and startup results where applicable.

B. Manual Preparation - Manuals shall include operation and maintenance information on all systems and items of equipment. The data shall consist of catalogs, brochures, bulletins, charts, schedules, approved shop drawings corrected to as-built conditions and assembly drawings and wiring diagrams describing location, operation, maintenance, lubrication, operating weight, lubrication charts and schedules showing manufacturer's recommended lubricants for each rotating or reciprocating unit, and other information necessary for Owner to establish effective operating and maintenance programs. The following shall also be included:

1. Title page giving name and location of facility, drawing number where shown, and specification section where described.

2. Equipment cover sheet listing the supplied equipment manufacturer's name, brand name, model numbers, serial numbers, equipment installer (provide contact name, address, phone and fax numbers, and e-mail address), equipment supplier (provide contact name, address, phone and fax numbers, and e-mail address), and equipment manufacturer (provide contact name, address, phone and fax numbers, e-mail address, and website address).

3. Performance curves for all pumps and equipment.

4. Approved shop drawings of each piece of equipment.

5. Design criteria for the equipment, in table format. Information shall include standard size information such as length, width, or diameter, and capacity information such as flow and head that is not included in the nameplate table.

6. Troubleshooting in table format as follows:

Problem	Possible Causes	Corrective Action

7. Nameplate data for the equipment in table format. Nameplate information shall include data for the overall assembly and any major components such as motors, gear reducers, etc.

8. Manufacturer's cut sheets and dimensional drawings of each piece of equipment, and details of all replacement parts.

9. Manufacturer's erection, operation, and maintenance instructions for all equipment and apparatus, and complete listing of nameplate data.

10. Complete electrical and control schematics with labeled terminations for all individual pieces of equipment and systems including one line diagrams, schematic or elementary diagrams, and interconnection and terminal board identification diagrams.

11. A description of the controls provided with the equipment.

12. Complete piping and interconnecting drawings.

13. Complete parts list with parts assembly drawings (preferably by exploded view), names and addresses of spare parts suppliers, recommended list of spare parts to be kept “in stock” and sample order forms. Lead time requirements for ordering parts shall be estimated.

14. Instructions with easily understood schematics or diagrams for disassembling and assembling equipment for overhaul and repair.

15. Shop testing results where applicable.

16. Manufacturer’s Installation Certificate.

17. Manufacturer’s Certificate of Equipment Compliance.

18. Field testing/performance reports where applicable.

19. Manufacturer’s equipment warranty.

20. Information not applicable to a specific piece of equipment installed on this project shall be removed from or crossed out on the submissions.

21. Illegible data due to any cause, including poor copy quality or reduction, will not be accepted. Manuals with illegible data will be rejected and returned for correction.

C. Organization - O&M Manuals shall be organized as follows:

1. All instructions shall be bound into a series of identical 3- or 4-inch heavy-duty three-ring binders. Where necessary, more than one binder may be used to assemble the data. When two or more binders are used, each book or volume shall be titled to indicate its particular book or volume number and the total number of volumes per set (i.e., Volume 2 of 12). The Contractor shall plan manual content and shall “break” the data between volumes at reasonable locations so no loss in continuity of data presentation occurs.

2. Information shall be organized by specification section, each covering an individual equipment item.

3. Sections shall be listed in a Table of Contents at the front of each volume.

4. Shop drawings 24 inches by 36 inches in size shall be folded to approximately 12 inches by 9 inches with drawing title box exposed along either edge. Shop drawings descriptive of a single item of equipment shall be grouped together and fully indexed on the outside of the folders in a neat and uniform manner.

5. All shop drawings included in the binders and/or folders shall be those previously submitted for review and approval and shall bear Engineer’s stamp of approval and comments as originally noted thereon.

D. Electronic Operations and Maintenance Data

1. In addition to the specified printed operations and maintenance materials, furnish all specified operations and maintenance materials in electronic format with the final draft operations and maintenance manual submittals prior to Substantial Completion. Electronic equipment manual files shall be submitted in Adobe Acrobat Reader (.PDF) format.

2. Electronic files shall be submitted on one or more compact disks (650 MB CD). Two sets of compact disks shall be provided, one for Owner and one for Engineer. CDs and covers shall be labeled with the project name, supplier, equipment identification, and specification section. CDs shall be provided in individual hard plastic cases.

1.15. LUBRICATION

A. For equipment that requires lubrication, manufacturer shall prepare a lubrication schedule for all equipment utilizing lubricants from as few companies as possible (preferably single source).

B. Include lubrication schedule in the operation and maintenance instructions.

1.16. FAILURE OF EQUIPMENT TO PERFORM

A. Promptly correct by replacement or otherwise any defects in the equipment, or failure to meet the guarantees or performance requirements.

B. If Contractor fails to make these corrections, or if the improved equipment again fails to meet the guarantees or specified requirements, the Owner, notwithstanding his having made partial payment for work and materials which have entered into the manufacture of said equipment, may reject said equipment and order the Contractor to remove it from the premises and provide equipment that meets the performance requirements, specifications and warranties at the Contractor's expense.

1.17. GUARANTEE

A. Provide equipment guarantees in accordance with the General Contract Conditions. Guarantee requirements may be added to or modified in the individual specification sections.

B. Manufacturer Warranties During Correction Period

1. Where indicated in the individual specification sections, provide a one-year manufacturer warranty made out in the name of the Owner, coinciding with the correction period defined in General Contract Conditions for the particular piece of equipment.

2. One copy of each manufacturer warranty shall be provided to both Owner and Engineer within 30 days of successful completion of startup.

3. All requirements of the correction period defined in General Contract Conditions shall apply to the manufacturer’s warranty and the equipment supplier obligations shall be the same as Contractor obligations defined in General Contract Conditions for the particular piece of equipment covered by the warranty.

C. Special Guarantees - Provide both Owner and Engineer one copy of special guarantees required in individual specification sections. Special guarantees shall be made out in the Owner's name.

1.18. EQUIPMENT SCHEDULE

A. The attached schedule outlines the various items of equipment specified in other sections and lists the responsibilities of the equipment manufacturer for each section of the specifications for Contract No. RFB-RC-SWR-2022-06.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

(continued)

SCHEDULE OF EQUIPMENT TESTING AND MANUFACTURER'S SERVICES

Equipment Name	Spec Section[1]	X= Required[1]				Services of Manufacturer's Representative[1,2,4]						Operation and Maintenance Manual[1]	Video Recording of Training Required[1]
		Performance Affidavit	Shop Tests	Field Tests	Certification of Equipment Compliance	Installation	Preliminary Field Test	Functional Test	System Demonstration	Startup	Training		
Slide Gates	11291	X	X	X	X	1/2		2	1/2		1/2	X	X
Vertical Centrifugal Pumps	11306	X	X	X	X	12	6	6	6	12[3]	1	X	X
Valve Actuators	15100	X	X	X	X	1	-	3	-	3	1/2	X	X
Variable Frequency Drives	16480	X	X	X	X	--	1	1	1	1	1/2	X	X
Programmable Logic Controllers (PLC)	17095	X	X	X	X	1/2	--	--	5	2	1	X	X
Flow Meter	17095	--	--	X	X	1/2	--	1/2	1/2	1	1/2	X	X
Bubbler System	17095	--	--	X	X	1	--	1	--	2	1/2	X	X

(1) Refer to individual specification sections for additional details

(2) All times are actual on-site times and represent minimum requirements. For equipment specified in Section 11306, Vertical Centrifugal Pumps, Contractor must provide a qualified representative who is a direct employee of the manufacturer (factory representative) for all required services. Minimum of six (days) shall be allotted for each pump within the overall schedule.

(3) Final acceptance will not be given until the new equipment has run for a two consecutive week demonstration period under normal operating conditions. If a fault occurs, or if excessive vibration is detected, the two-week demonstration period will restart upon correction of the problem.

(4) Two separate trips; one for each unit/system/location. On-site times may not necessarily be consecutive days based on Contractors work sequence.

EQUIPMENT CHECK-OUT AND CERTIFICATION FORM

Project:			
Company:		**Report No.:**	
Name of Equipment:		**Date:**	
Equipment Tag:		**Contract No:**	
Specification Section:		**Model No.:**	
Show Drawing Item No.:		**Serial No.:**	

_____, as the authorized Manufacturer's Representative for the above- referenced equipment, hereby certifies that I have completely inspected, aligned, operated and adjusted said equipment on this date and the equipment is ready to be operated for its intended use

Equipment Evaluation Checklist	Completed and Acceptable	Deficient Explanation Below	N/A
No visible corrosion or mechanical damage to the equipment.			
Nameplates are correct.			
All mountings are secure, all piping is attached, all belts and drives are installed and tensioned correctly, shafts are aligned correctly and all safety features are in place.			
Prerequisites and preliminary tests for low voltage motor control centers, adjustable frequency drives, and all other electrified equipment, have been completed. Verify all control and power circuits to the equipment are energized.			
Factory test reports have been received and approved.			
All applicable prerequisites and preliminary tests for subsystems and auxiliary equipment have been completed.			
Motors have been bumped to verify correct rotation.			
Seal water system is operational.			
Valves are operational and are in proper open or shut positions.			
All feed and drain lines are installed and operational.			
The equipment has been checked against the approved shop drawing and complies with all details, including comments by the Engineer.			
All equipment has been properly lubricated in accordance with manufacturer's requirements.			

Deficiencies Observed:

Corrections Made:

Special Instructions:

Training (Check One):	
	_____ hours of training on equipment operation and maintenance was given on _____ to the following personnel:
	No training was provided; it will be scheduled for a later date.
	No training is required.

Manufacturer's Certification Statement:

The equipment is complete, conforms to the requirements of the Contract and is ready for permanent operation. There is nothing in the installation that will render the Manufacturer's warranty null and void.

Authorized Signature _____

Title _____ Date _____

The equipment is ready for permanent operation and nothing in the installation will render the Manufacturer's warranty null and void. The deficiencies noted are minor and will not adversely affect the equipment operation. The deficiencies will be corrected at a later date.

Authorized Signature _____

Title _____ Date _____

The equipment certification cannot be completed at this time.

Authorized Signature _____

Title _____ Date _____

Witnessed by Contractor:

Authorized Signature _____

Title _____ Date _____

Witnessed by Engineer:

Authorized Signature _____

Title _____ Date _____

Attachments (List Manufacturer's Field Report):

**Attach Manufacturer's Check-Out Report.*

END OF SECTION

SECTION 01660

TESTING AND STARTUP

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Definitions.

B. Submittals.

C. General

D. Preliminary field testing.

E. Functional testing.

F. PCS Programming Phase

G. System demonstration testing.

H. Startup.

I. Meetings.

1.02. DEFINITIONS

A. System - The combination of subsystems that will collectively undergo sequential system demonstration testing, startup, and delivery to the Owner. Each system includes all components necessary for that system to function as intended, including structural/architectural components, HVAC, plumbing, process equipment, piping, power, automated controls, life safety, etc.

B. Subsystem - The multiple components of a system. Subsystems are generally defined as unit processes and support systems, including structural/architectural components, HVAC, plumbing, process equipment, piping, power, automated controls, life safety, etc.

C. Process Control System (PCS) - Programmable logic controllers (PLCs) and Supervisory Control and Data Acquisition (SCADA) network.

D. System Delivery Plan - Contractor’s schedule for delivering systems to the Owner.

E. Preliminary Field Test - Field test to demonstrate that equipment is properly installed and ready for operation.

F. Functional Test - Field test to demonstrate successful operation and performance of equipment in all intended modes of operation, including operation from remote devices with the exception of the PCS.

G. PCS Programming Phase - Period of time for PCS programmer to load, test, and debug PCS application software.

H. System Demonstration Testing - Continuous successful operation of a system in its entirety utilizing a testing fluid prescribed by the Owner for seven consecutive days prior to startup of that system.

I. Startup - Continuous successful online operation of a system in its entirety utilizing actual process fluid and at actual service conditions for seven consecutive days prior to delivery of that system to the Owner.

1.03. SUBMITTALS

A. Functional Testing Plans

1. Submit at least 30 days prior to proposed functional testing date in accordance with procedures identified in Section 01300, Submittals.

2. Submit individual plans for each piece of equipment requiring a functional test.

3. Coordinate with Owner to determine testing fluid sources and include in functional testing plans.

B. System Delivery Plan

1. Submit within 60 days of Notice to Proceed in accordance with procedures identified in Section 01300, Submittals.

2. Define each system to be independently delivered to the Owner after startup.

3. At a minimum, the System Delivery Plan shall include the following systems at the Union Hill and Tallman Pump Stations:

a. Pump Stations:

1) Pumps.

2) Associated Electrical and Controls.

3) Plumbing equipment, at Union Hill Pump Station.

b. HVAC systems.

4. Proposed start and finish dates for all system demonstration tests and startup.

5. Incorporate into progress schedule.

6. Resubmit proposed changes in accordance with accordance with procedures identified in Section 01300, Submittals.

C. System Demonstration Testing and Startup Plans

1. Submit a minimum of 30 days prior to proposed system demonstration test date in accordance with procedures identified in Section 01300, Submittals.

2. Identify all testing media sources and disposal locations including testing fluid, sludge, utility water, chemicals, process air, instrument air, etc. for both system demonstration testing, and startup.

3. Identify all instrumentation and recording devices required to complete testing.

4. Identify all required laboratory testing.

5. Identify days during which the manufacturer's representatives will be on site.

1.04. GENERAL

A. Provide a minimum of 14 days' notice to the Owner and Engineer prior to all testing. The Owner and Engineer reserve the right to witness all testing.

B. Materials, Supplies, and Utilities

1. Owner Furnished, Unless Otherwise Specified

a. Power during testing.

2. Contractor Furnished

a. All required tools, materials, and spare parts.

b. All required instrumentation and monitoring devices, including temporary devices required for testing (i.e., flow meters, pressure gauges, level sensors, etc.)

c. All required fuel, lubricants, energy, equipment, and instruments.

d. All required utilities not furnished by the Owner.

e. Laboratory services where specified or otherwise required.

f. Provide means to convey designated testing fluid to testing location and to disposal location unless otherwise indicated, including all temporary facilities required (i.e. pumps, piping, etc.).

C. Connection to Existing Equipment and Facilities - Test all equipment and facilities to ensure that they are in operating condition before the final tie-ins are made which connect new equipment and facilities to existing equipment and facilities.

D. Contractor Operating Personnel

1. System Demonstration Testing

a. Provide the following on call personnel that are capable of arriving at the site within two hours after request by Contractor furnished and monitored alarms:

1) One person per prime contract associated with testing.

2. Startup

a. Provide 24-hour per day on-site personnel that are thoroughly familiar with all the equipment and construction. At a minimum, 24 hours per day staff shall include the following: None.

b. Provide the following on-call personnel capable of arriving at the site within two hours after request: One qualified person per prime contract

E. Tagging System

1. A tagging system will be provided by the Contractor and used by Engineer to document testing and startup progress as follows:

a. Yellow Tag - Preliminary Field Testing complete.

b. Red Tag - Functional Testing Complete.

c. Blue Tag - Successful completion of Startup.

2. Tags will be signed and dated by Engineer upon acceptance, and shall remain attached to the item until ordered removed by Engineer.

1.05. PRELIMINARY FIELD TESTING

A. Demonstrate the following:

1. Equipment is permanently installed in the correct location and orientation.

2. Equipment is properly adjusted, aligned, and lubricated.

3. Equipment is prepared for operation in strict accordance with the Contract Documents and with manufacturer's recommendations.

B. Make all changes, adjustments and replacements required to comply with the requirements of the Contract Documents.

C. Preliminary field testing shall be witnessed by the manufacturer's representative where required by Section 01640, Equipment-General, and the individual specification sections.

D. Prerequisites

1. Accepted System Delivery Plan.

2. Permanent power has been connected and unit is ready for operation.

1.06. FUNCTIONAL TESTING

A. At a minimum, functional tests shall include the following:

1. Verification that equipment meets the specified performance requirements in every detail and performs its intended function without any unusual vibration, noise or other signs of possible malfunction. Unless specifically identified otherwise in individual specification sections, all performance testing shall be conducted during functional testing.

2. Motor testing where required.

3. Vibration testing where required.

4. Demonstration of successful operation in all control modes including all remote devices except the PCS.

B. Prerequisites

1. Accepted Functional Testing Plan.

2. Preliminary field testing.

3. Manufacturer's Installation Certificate.

4. Final Draft Operations and Maintenance Manual.

C. Testing fluid shall be non-potable water unless otherwise specified or required by Owner.

1.07. PCS PROGRAMMING PHASE

A. Loading, testing, and debugging PCS application software will be provided by others. Electrical Contractor and subcontractors shall provide assistance to programmer as required by the Division 17 specifications.

B. PCS programming phase work shall be performed on a system-by-system basis.

C. General and Electrical Contractor shall allocate 21 days in the progress schedule for the PCS programming phase for each defined system.

D. The PCS programming phase shall not occur for a given system prior to the following:

1. Engineer has witnessed and accepted PCS testing requirements specified in Division 17 for that system.

2. Programmer has confirmed the PCS hardware is functioning properly, the required equipment and instrumentation is ready for operation, all necessary field wiring is complete and terminated, and Contractor has resolved all previously identified issues.

E. Contractor shall not schedule concurrent programming phase work for the following: N/A.

1.08. SYSTEM DEMONSTRATION TESTING

A. Operate system in simulated fashion as described in the accepted System Demonstration Testing and Startup Plan demonstrating all modes of operation. This shall include, when practical, simulation of extreme conditions so as to check the response of instrumentation and control devices, bypass functions, pumping cycles, etc. Contractor shall be responsible for the complete operation of the system, including the positioning of valves, gates, switches, proper equipment devices, controls and associated components furnished and/or installed under this contract. Owner will provide operation of all existing pump station components unless otherwise specified.

B. If any component of the system fails to operate in accordance with the Contract Documents during system demonstration testing, provide all necessary repairs, maintenance, replacement of parts, corrections, adjustments, and other actions necessary to restore proper operation of the system. Required adjustments to equipment shall be made by a qualified manufacturer's representative. After the system is restored to proper operating conditions, restart the test. No credit will be given for operating time prior to system failures when calculating test durations.

C. Equipment shall be powered from the permanent power source prior to system demonstration testing.

D. Prerequisites

1. Accepted System Demonstration Testing and Startup Plan.

2. Functional testing of all system components.

3. Manufacturer's Certification of Equipment Compliance for all associated equipment.

4. Associated system demonstration testing and startup meeting.

5. Required training for all system components not specifically identified in individual specifications sections as post startup training.

6. Leakage testing of associated piping and tanks.

7. Permanent safety and protection devices installed and operational. Safety devices shall include, but not be limited to, fall protection, hand railing, grating and floor plates, leak detection, motor thermal and overload protection, emergency power generation, equipment lockouts, floatation devices, fire alarms and systems, ventilation systems, and lighting in operational areas in or directly related to the system being tested. All open excavations in or adjacent to the operational areas shall be covered.

8. Verification that all required lubrication equipment and materials are readily available to Contractor at the site.

9. System piping, valves, instruments, control panels, and electrical equipment properly labeled in accordance with the Contract Documents.

10. Control system testing as defined in Division 17 for systems controlled by the SCADA network, with the exception of the integrated system test

11. PCS programming phase.

12. Loading of application software for systems controlled by the control system.

E. Testing fluid shall be non-potable water or treated effluent unless otherwise specified or required by Owner.

1.09. STARTUP

A. Operate system under Owner's direction demonstrating all modes of operations. This shall include, when practical, simulation of extreme conditions so as to check the response of instrumentation and control devices, bypass functions, pumping cycles, etc. Contractor shall be responsible for the complete operation of the system, including the positioning of valves, gates, switches, proper equipment devices, controls and associated components furnished and/or installed under this Contract. Owner will provide operation of all existing pump station components and provide all required sampling and laboratory testing required for operation of system during Startup unless otherwise specified.

B. If any component of the system fails to operate in accordance with the Contract Documents during Startup, provide all necessary repairs, maintenance, replacement of parts, corrections, adjustments, and other actions necessary to restore proper operation of the system. Required adjustments to equipment shall be made by a qualified manufacturer's representative. After the system is restored to proper operating conditions, restart the test. No credit will be given for operating time prior to system failures when calculating test durations. Examples of system failures include, but are not limited to the following:

1. Tank overflows.

2. Equipment failures and/or malfunctions.

3. Instrumentation failures and/or malfunctions.

4. Tank or piping failures and/or leakage.

5. Loss of power to equipment and/or devices.

C. Upon successful completion of startup, the system shall be delivered to the Owner for partial utilization.

D. Prerequisites

1. System demonstration testing.

2. Provide Owner with up-to-date record drawings showing all components as they are installed. The record drawings shall cover all major components of the system including power feed, control and alarm annunciation, and piping.

3. Seven days written notice prior to proposed actual beginning of startup date. Startup cannot commence without Owner and Engineer acceptance of proposed actual beginning of Startup date

1.10. SYSTEM DEMONSTRATION TESTING AND STARTUP MEETINGS

A. At least 14 days prior to the proposed start date for each system demonstration test, conduct a meeting with Owner and Engineer to review testing plans, finalize testing procedures, verify status of associated equipment and prerequisites, and coordinate all aspects of system demonstration testing and startup. Representatives of the Owner, Engineer, and Contractor shall attend the conference.

B. Prerequisites

1. Accepted System Demonstration Testing and Startup Plan.

2. Completion of all associated functional testing.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01700

CLOSEOUT AND RECORD DOCUMENTS

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Closeout procedures.

B. Record documents.

1.02. CLOSEOUT PROCEDURES

A. Contract closeout procedures shall be in accordance with GC-14.06 GC-14.07 and as specified herein.

B. Correct or replace all defective work in accordance with the requirements of Article 13 of the General Conditions.

C. The following items shall be provided by the Contractor prior to Final Application of Payment:

1. Spare parts, maintenance and extra materials in quantities specified in individual specification sections. Deliver to project site and place in location as directed; obtain receipt prior to final payment.

2. Provide duplicate notarized copies of certifications for those items with extended transferable warranties beyond one year. Prepare separate submittal for each item.

3. Warranties and Bonds - Provide duplicate notarized copies of certifications for those items with extended transferable warranties beyond one year. Prepare separate submittal for each item.

a. Execute and assemble documents from subcontractors, suppliers, and manufacturers.

b. Provide Table of Contents and assemble in three D-side ring binder with durable plastic cover.

c. Submit prior to final Application for Payment.

d. For items of work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance, listing date of acceptance as start of warranty period.

4. Operation and maintenance manuals as specified in Section 01640, Equipment-General.

1.03. RECORD DOCUMENTS

A. The following supplements the requirements of GC-6.12:

1. Record, keep, and monitor up-to-date record documents of work constructed in the field. Legibly mark in red ink or red pencil to show all changes in, or directly associated with, the work of this contract. Keep entire set of record documents current on a day-to-day basis. Record documents shall be kept on hand in the Contractor's field office and shall be available for periodic examination by Engineer upon request.

2. Examples of annotations that could occur are as follows:

a. Change in location or elevation of structures.

b. Change in dimensions of structures.

c. Elimination of structures.

d. Unforeseen modifications to existing structures.

e. Relocation of equipment.

f. Additions to or expansion of structures.

g. Changes in mechanical trades components; (electrical, heating, ventilating, plumbing).

h. Measured location of internal utilities or mechanical trade items, which are to be concealed from view, referenced to visible and accessible features of the structure.

i. Change in location or elevations of Underground Facilities installed under this Contract.

j. Change in materials, such as pipe materials.

k. Relocation of existing underground facilities.

l. Change in topographical contours of finished earth and paved surfaces.

m. Change in elevations of finished surfaces along route of installed underground facilities.

3. Show measurement of pipeline location from edge of pavement, at a minimum of 100-foot intervals.

B. Final Record Drawings - Provide the pipe sizes and horizontal and vertical location of all valve boxes, air release valves, curb boxes, meter pits, and other appurtenances. The information will be provided digitally in the form of an AutoCAD .dwg file and be consistent with the plan datum and control as shown on the Drawings. The Contractor will employ the services of a registered professional surveyor licensed in the State of New York to provide elevation information. Contractor can request Contract Drawings in .dwg format from the Engineer. Contractor shall comply with the Owner's and Engineer's requirements in order to obtain the Drawings. Final record drawings shall be prepared in AutoCAD.

C. At Substantial Completion, affix Contractor's red identification stamp to front cover of each set of record documents and label them as "Record Documents." One set of record documents shall be given to Engineer no later than 14 days after the date of Substantial Completion. Engineer will either approve record documents or return them to Contractor with comments. Contractor shall resubmit record documents until Engineer has no further comments. Affix Contractor's identification stamp, together with the label "Record Documents," as follows:

1. On each drawing, just above the Engineer's title block.

2. On each shop drawing, just above the preparer's title block.

3. On the front cover or front page of all other documents.

D. Final payment to Contractor will not be considered until acceptable record documents have been turned over to Owner.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 02030

DEMOLITION

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Demolition and removal of site-related construction.

B. Demolition and removal of architectural construction.

C. Demolition and removal of process equipment, valves, fittings and piping.

D. Demolition and removal of electrical construction.

E. Demolition and removal of HVAC construction.

F. Demolition and removal of plumbing construction.

G. The limited Hazardous Materials Survey included as Appendix A in this Project Manual summarizes sampling undertaken on behalf of Owner. The survey report identifies locations of possible hazardous materials at the Main Pump Station. The survey is intended to be a reference and may not be inclusive of all the hazardous materials present at the project facilities.

H. The Contractor is responsible for demolition, removal, and disposal of all hazardous materials. The Contractor is responsible to coordinate demolition work and sequencing. The Owner reserves the right to take ownership of demolished equipment. Coordinate with Owner prior to removal from site.

1.02. SUBMITTALS

A. Submit under provisions of Section 01300, Submittals.

B. Each Contractor shall submit a detailed demolition work plan for all demolition activities including all necessary diagrams and/or drawings accounting for Owner’s continuing occupancy and the sequence of construction. A separate work plan shall be developed for demolition and removal of hazardous materials. The demolition work plan shall include the following at a minimum:

1. Identify items to be demolished and discuss the demolition, removal, and disposal procedures.

2. Disposal locations of removed items.

3. Relocation of salvageable items.

4. Temporary storage of items to be reused.

5. Timelines and sequence or work.

6. Location of temporary barricades, fences, and signs.

7. Provisions for disposal of sludge, grit, and debris.

C. The work plan shall be reviewed by the Engineer prior to the commencement of all demolition work.

1.03. PROJECT RECORD DRAWINGS AND PHOTOGRAPHS

A. Submit under provisions of Section 01700, Closeout and Record Documents.

B. Accurately record actual locations of capped utilities, subsurface obstructions.

1.04. REGULATORY REQUIREMENTS

A. Conform to applicable codes for demolition of structures, protection of adjacent structures, dust control, runoff control, and disposal of materials.

B. Obtain required permits from authorities.

C. Notify affected utility companies before starting demolition operations and comply with their requirements.

D. Do not close or obstruct roadways, sidewalks, hydrants, or parking areas without required permits.

E. Conform to applicable regulatory procedures if a hazardous environmental condition is encountered at site or if hazardous material disposal is required.

1.05. HAZARDOUS ENVIRONMENTAL CONDITIONS

A. If an unknown unforeseeable hazardous environmental condition is encountered at the site, or if Contractor or anyone for whom Contractor is responsible creates a hazardous environmental condition, immediately:

1. Secure or otherwise isolate such condition;

2. Stop all work in connection with such condition and in any area affected thereby; and

3. Notify Owner and Engineer (and promptly thereafter confirm such notice in writing).

B. Resume work in connection with such condition or in any affected area only after Owner has obtained any required permits related thereto and delivered to Contractor a written notice specifying under what special conditions work may be resumed safely.

1.06. SEQUENCING

A. Sequence demolition work to conform with provisions of Section 01010, Summary of Work.

B. The Contractor is responsible for demolition, removal, and disposal of all hazardous materials. The Contractor is responsible to coordinate hazardous materials demolition work, and sequencing with, the Engineer, and the Owner.

C. Existing equipment and structures shall not be demolished or removed from service until the new replacement equipment and material necessary to construct the new structures and complete the work is on site and ready for installation. Treatment processes shall not be removed from service unless all necessary equipment and material necessary to complete the work is on site and ready for installation. Contractor shall minimize the time equipment and treatment processes are out of service.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01. PREPARATION

A. Notify Owner and Engineer at least 48 hours in advance of intended start of demolition operations in each affected area.

B. Provide, erect, and maintain temporary barriers, signs, and security devices.

C. Erect and maintain temporary partitions and weatherproof closures to prevent spread of dust, odors, and noise in areas of continued Owner occupancy identified in Section 01010, Summary of Work.

D. Protect existing structures, equipment, appurtenances, architectural features, and materials which are not to be demolished. Prevent movement or settlement of adjacent structures.

E. Protect existing site-related items such as pavements, walkways, parking areas, curbs, aprons, and landscaping features which are not to be demolished.

F. Protect existing electrical; heating, ventilating, and air conditioning; and plumbing systems, including related components, which are not to be demolished.

G. Mark location of underground utilities.

3.02. DEMOLITION REQUIREMENTS

A. Confine demolition operations within the contract limits.

B. Conduct operations to minimize interference with adjacent and occupied building areas. Maintain protected egress and access at all times.

C. Cease operations immediately if adjacent structures appear to be in danger. Notify Engineer. Do not resume operations until directed.

D. All materials, except rubble and non-metallic scrap, shall become the property of the Owner if required.

E. Dispose of rubble and non-metallic scrap.

F. Dispose of designated hazardous materials in accordance with the nature of the material, required handling and disposal procedures, regulatory requirements, and applicable permits.

3.03. DEMOLITION

A. Break up and remove slabs-on-grade, pavements, curbs, aprons, etc., and related items in designated areas.

B. Break up and remove foundation walls, footings, etc., including any below-grade concrete slabs, to a point 2 feet below grade.

C. Break up and remove concrete structures and tanks, including walls, piers, base slabs, cover slabs, etc.

D. Empty and remove buried tanks, meter pits, and associated piping.

E. Backfill, compact, and rough grade areas excavated, including cavities created by removal of demolished items, in accordance with Section 02223, Backfilling.

F. Disconnect cap and identify utilities within demolition areas.

G. Remove designated buried sewer and storm drain piping systems, capping with concrete plugs those segments to be abandoned, and provide temporary capping of those segments to be reused.

H. Disconnect and remove designated process piping systems, including valves and fittings; provide temporary capping of those segments of the system to be reused. Plug openings in walls and floors where utilities are removed.

I. Detach, dismantle, and remove metal components of process equipment from designated buildings, including miscellaneous metal work items associated with access to and operation of such equipment.

J. Carefully disconnect support, protect, and remove designated equipment to be reused on the project or salvaged for Owner's future use.

K. All removed materials and equipment designated for reuse on the project, or salvaged for Owner's future use, shall be protected from damage and from deterioration by weather.

L. Remove and dispose of demolished materials as work progresses. Do not burn materials; do not bury materials.

M. Patch and refinish existing visible surfaces which are to remain.

N. Paint designated metal surfaces and reinforcing steel exposed by demolition operations, in accordance with Section 09900, Painting.

O. Remove temporary barricades, partitions, signs, etc.

P. Remove and dispose of residual materials such as grit, sludge, debris, trash, and other scrap.

Q. Upon completion of demolition operations, leave areas in a clean condition.

END OF SECTION

SECTION 02112

PAVEMENT CUTTING

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Pavement cutting.

B. Pavement scoring.

C. Pavement (concrete) breaking.

D. Pavement removal and disposal.

1.02. REFERENCES

1.03. REGULATORY REQUIREMENTS

A. Coordinate pavement cutting with Owner or utility companies.

B. Conform to applicable local, state, and federal codes for legal disposal of pavement materials.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01. PREPARATION

A. Set up barricades, warning signs and traffic direction information prior to start of pavement cutting.

3.02. PAVEMENT CUTTING AND BREAKING

A. Pavements covering those areas to be excavated shall be broken up, removed, and then disposed of in accordance with Article 1.04 above. All paved areas shall be first cut or scored continuously along a straight line, parallel to and on each side of the centerline of the trench or excavation, at a width sufficient for the trench excavation or structure excavation.

B. Pavement cuts in concrete pavement or pavement with a concrete base shall be made by scoring or cutting the concrete with a concrete saw. The depth of the saw cut shall be to the full depth of the concrete pavement thickness. Before excavation, the concrete pavement shall then be broken up with hand operated, pneumatic paving breakers, or mechanical drop hammers designed for such purpose, providing they may be used without endangering existing utilities or causing undesirable vibrations. “Headache balls” will not be permitted for breaking up concrete pavement.

C. Pavements cuts in blacktop pavement shall be made byscoring or cutting the pavement with a concrete saw, wheel cutter, pneumatic paving breaker or drop hammer type pavement cutter. The pavement cut must be continuous, and made for the full depth of the pavement.

D. Pavement cuts for final pavement replacement shall be made as outlined above. Pavement cuts shall be made parallel to the centerline of the trench, shall be located at a minimum of 12 inches outside the backfilled trench on undisturbed subgrade and shall be in a straight line for minimum length of 100 feet between manholes or between those stations where changes in direction of the installed piping were made. Where a full street width overlay is to be installed the cutbacks may follow the backfilled trench alignment. Loose, torn, cut, marked up or damaged pavement outside the cutback areas shall be removed and replaced at the Contractor's expense and match the proposed permanent paving.

E. Pavement cuts in driveways shall be made in a straight alignment perpendicular or parallel to the driveway and for its full width.

F. Pavement cuts in parking areas shall be made in a straight alignment parallelto the centerline of trench.

END OF SECTION

SECTION 02141

REMOVAL OF WATER

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Providing equipment, materials and labor required to successfully complete the work included in this section.

B. Maintaining and operating pumps and related equipment, including standby equipment, of sufficient capacity to adequately perform dewatering as required by this section.

C. Lowering the groundwater table elevation.

D. Intercepting seepage from excavation slopes.

E. Controlling groundwater flow that may adversely affect excavation or construction activities.

F. Collecting, removing and disposing of all excess groundwater.

G. Collecting, removing, and disposing of all wastewater.

H. Removing and/or disposing of spoil, excess materials, equipment, trash and debris used for or resulting from the work included in this section.

1.02. REGULATORY REQUIREMENTS

A. Conform to applicable local, state and federal requirements for legal disposal of water.

B. Temporary water supplies shall meet requirements of local, state and federal regulatory agencies.

C. Conform to applicable OSHA standards.

1.03. WELLPOINT DEWATERING SYSTEM

A. If wellpoint dewatering methods are proposed by Contractor, he shall prepare a plan of dewatering system and discuss plan with Owner and Engineer. Review or comments by Owner and Engineer concerning the proposed plan shall not relieve Contractor of his responsibilities for dewatering his excavations in conformance with this section of the specifications.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01. PREPARATION

A. Review subsurface investigation reports and conduct appropriate investigations to become familiar with the groundwater conditions at the site. Allocate sufficient time and use appropriate procedures based on these conditions for dewatering excavations.

B. Examine adjacent structures and utilities, both existing and under construction, for possible settlement, movement or other adverse effects resulting from dewatering methods or water removal. Take necessary precautionary steps to protect such structures and utilities.

3.02. REMOVAL OF WATER

A. Assume responsibility for site, surface and subsurface drainage. Maintain such drainage as specified herein during the life of the contract.

B. Supply all supervision, labor, material, equipment, including standby equipment, necessary to maintain a dry excavation as may be necessary to construct the project.

C. Maintain groundwater in or below the bearing strata at a safe level at all times by methods which prevent loss of fines, which preserves the undisturbed state of subgrade soils and which sufficiently lowers the groundwater level in permeable strata at or below excavation and fill levels such that blowing or unstable conditions do not develop in the bottom or sides of excavation or fill areas.

D. Protect all adjacent structures, existing and under construction, from settlement, flotation, damage or other adverse effects resulting from water removal or dewatering methods.

E. Install all drains, ditching, sluiceways, pumping and bailing equipment, wicking, sumps, wells, well points, cutoff trenches, curtains, sheeting and all other equipment and structures necessary to create and maintain a dry excavation and a groundwater level at a minimum of 2 feet below excavation subgrades.

F. Discharge water removed from the site to natural watercourses, storm drains, or channels.

1. Large quantities of water shall not be discharged as overland flow. Overland flow is not permitted onto private property.

2. Water shall not be discharged to storm or sanitary sewers without the prior approval of the Engineer or Owner.

3. Wastewater shall be disposed of in a manner satisfactory to the local Public Health Officer.

G. Dewatering operations shall cease when all foundations, structures, pipe installations and other excavated areas have been properly backfilled and compacted, and are safe from damage, flotation, settlement and displacement.

3.03. MAINTENANCE

A. Operate and maintain dewatering and removal operations on a 24-hour basis for the time required to complete that portion of the work which requires dewatering prior to its construction and which requires protection from flotation or displacement of such work until proper backfilling and compaction is completed.

3.04. REMOVAL

A. After groundwater levels have returned to elevations appropriate for conditions and time of year, without causing damage to the work, remove all dewatering equipment and related equipment from the site and restore site to original conditions or rehabilitate site to meet requirements of Contract Documents.

END OF SECTION

SECTION 02161

SHEETING AND BRACING

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Sheeting and bracing installation, removal, and left in place.

B. Design requirements.

C. Regulatory codes and requirements.

D. Materials.

1.02. REGULATORY REQUIREMENTS

A. All sheeting and bracing including the use of mobile shields shall conform to Public Law 91-596 (Williams Steiger Act); the Occupational Safety and Health Administration Act (OSHA) of 1970 and its amendments and regulations; or to the New York State Industrial Code Rule 23, entitled "Protection in Construction, Demolition and Excavation Operations" as issued by New York State Department of Labor, Board of Standards and Appeals; whichever is the most stringent.

B. Conform to New York State Industrial Code Rule 53, entitled "Construction, Excavation and Demolition Operations at or Near Underground Facilities" as issued by the State of New York Department of Labor, Board of Standards and Appeals.

1.03. REFERENCES

A. ASTM A6/A6M - General Requirements.

B. ASTM A328 - Steel Sheet Piles.

C. NFPA - National Forest Products Association.

1.04. SUBMITTALS

A. Contractor shall submit fully detailed drawings and design computations for all sheeting and bracing systems signed and sealed by a Professional Engineer registered in New York State. The submittal shall include dewatering systems and sequences of construction to be followed in placing and removing braces.

PART 2 PRODUCTS

2.01. MATERIALS

A. Steel - ASTM A36 as required by ASTM A328.

B. Trench Boxes - Fabricated steel or aluminum.

PART 3 EXECUTION

3.01. PROTECTION

A. When so designated on the drawings or stated in the specifications or to comply with local, state, or federal (OSHA) regulations, or when sloped excavations are not feasible, not possible or allowed or if excavations endanger adjacent facilities, sheeting and bracing shall be installed by the Contractor.

3.02. DESIGN REQUIREMENTS

A. All sheeting and bracing shall be designed and monitored by a Professional Engineer licensed in New York State.

B. Design shall include all loading conditions to which the sheeting and bracing will be subjected during construction.

C. Design sheeting and bracing systems against failure from the maximum loads that will occur during construction, including surcharge loads and additional loading due to construction equipment.

D. Design sheeting and bracing systems to enable safe construction of structures, utilities and appurtenances, and prevent excessive ground loss, displacement of adjacent foundations, and displacement of the bottom of the excavation.

3.03. INSTALLATION

A. Provide all materials, equipment and labor necessary to construct and maintain all required excavation support systems.

B. Sheeting and bracing support systems shall include, but shall not be limited to, wall support such as wood sheeting, ringwales, lagging, soldier piles, steel sheeting, trench boxes and bracing members such as stringers, wales, struts, rakers, shores, tieback anchors, etc. necessary to prevent damage to the work and for the safety of workers, the general public or adjacent property.

C. No excavation shall be performed below a line drawn down and away at a slope of two horizontal and one vertical from the nearest footing or grade beam of the existing building or as shown on the drawings without providing sheeting, shoring and bracing to provide lateral support for soils beneath the foundations of the building and to prevent damage to the building.

D. Design of bracing shall be such as to permit proper installation of the utilities as shown on the Drawings.

E. Sheeting shall not be driven while concrete is being placed, or within 24 hours after placement, nor during pile load testing.

F. Do not brace to concrete without written approval of the Engineer.

G. Install sheeting and bracing systems in a logical sequence as excavation operations are performed.

1. If a prefabricated mobile shield is used, the bottom of the shield shall be maintained no greater than 2 feet above the bottom of the excavation.

2. Openings or troughs created by the use of a shield shall be filled and compacted in accordance with Sections 02223, Backfilling, and 02228, Compaction.

3.04. MAINTENANCE

A. Maintain sheeting and bracing systems as functional on a 24-hour basis.

B. Provide a means of determining movement of excavation walls, and adjacent soil, buildings and structures and utilities.

1. If movement or damage occurs, immediately cease all construction activities, install temporary measures to prevent further movement or damage and notify the Engineer.

2. Movement or damage due to failure of sheeting and bracing systems shall be permanently repaired as soon as possible, at no cost to the Owner and at no additional cost for time.

3.05. REMOVAL

A. Remove sheeting and bracing as the work progresses in a manner which shall prevent damage to finished work, adjacent structures and property.

1. All voids created by removal of sheeting and bracing shall be filled and compacted in accordance to the guidelines of Sections 02223, Backfilling and 02228, Compaction.

B. Sheeting to be left in place shall be new and unused material. Where shown on Drawings, specified or approved, sheeting shall be cut off as specified, or a minimum of 2-1/2 feet below proposed final grade.

1. Contractor may elect to leave sheeting and bracing in place (cut off as described above). If he elects to do so it shall be at his own expense and only with Engineer's approval.

2. Provide to the Engineer a drawing of cut-off sheeting locations. Drawing should show site plan with dimensioned locations of sheeting, type of material remaining, and depths or elevations to top and bottom of remaining sheet.

END OF SECTION

SECTION 02205

PROTECTION OF EXISTING FACILITIES

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Location of facilities.

B. Notification of Owners and authorities.

C. Coordination and preparation.

D. Protection of facilities.

E. Protection of sewers and storm drains.

F. Protection of water mains near sewers.

G. Abandonment of utilities.

H. Restoration of property markers.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01. LOCATION OF FACILITIES

A. Prior to construction, verify location of existing underground facilities near or adjacent to project.

1. Consult with appropriate Underground Facilities Protection Organization (Dig Safely New York), Owners of facilities, and arrange for field stake-out or other markings to show locations.

2. Perform exploratory excavation at key junctures and other critical points to aid in ascertaining locations.

B. Report field stake-out findings and results of exploratory excavations to Engineer if possible changes in project location or design are indicated because of suspected interferences with existing facilities. Allow Engineer sufficient time to determine magnitude of changes and to formulate instructions in that regard.

C. If location of an existing underground facility is uncertain, apply careful excavation and probing techniques during construction to locate and avoid damage to same.

3.02. NOTIFICATIONS OF OWNERS AND AUTHORITIES

A. Prior to construction, notify Owners of existing facilities, of general scope, nature and planned progress schedule of the work.

B. Notify Owners of nearby underground facilities when excavating is to take place in a particular area, allowing them reasonable time to institute precautionary procedures or preventive measures which they deem necessary for protection of their facilities.

C. When existing utilities, such as sewer, water, gas, telephone, or electric power are damaged or disturbed during construction, immediately notify affected Owner and Engineer.

D. Notify Police and Fire Departments, Owner and Engineer, immediately if hazardous conditions are created or have the potential for occurring, as a result of damage to an existing facility or as a result of other activities at project site. Hazardous conditions could be created from: fire, explosion, escape of gas, escape of fuel oil, gasoline or industrial fluids, downed electrical wires, and disrupted underground electrical cables.

3.03. COORDINATION AND PREPARATION

A. Discuss anticipated work schedule with Owner and Engineer at preconstruction meeting, including procedures to be followed if one or more utilities are damaged or disrupted. Develop contingency plans to address Contractor’s role in repair of damaged utilities.

B. Make preparations beforehand to repair and restore damaged utilities, including arrangements for standby materials and equipment to be promptly assembled at site and utilized immediately.

C. Adjust work schedules and personnel assignments as necessary to conform with requirements of Owner if any utilities are to be temporarily interrupted during construction. Cooperate with Owner in this regard to minimize the time of interruption.

D. Make preparations for and conform to applicable requirements of New York State Industrial Code Rule 53 (as amended April 1, 1975) entitled,“Construction, Excavation and Demolition Operations at or Near Underground Facilities,” issued by State Department of Labor.

3.04. PROTECTION OF FACILITIES

A. Plan and conduct construction operations so that operation of existing facilities near or adjacent to the work, including electric, telephone, sewer, water, gas or drainage utilities, are sustained insofar as the requirements of the project will permit.

B. Protect existing facilities from damage or movement through installation of adequate support systems and use of proper equipment, including application of careful excavation and backfilling techniques in sensitive areas.

C. Existing utilities and other facilities which are damaged by the Contractor’s construction operations shall be promptly repaired by Contractor to the satisfaction of the affected Owner. Such repair work shall be done at Contractor's expense.

D. When aboveground visible facilities such as poles, wires, cables, fences, signs or structures constitute an unavoidable interference, notify and consult with Owner and Engineer regarding temporary removal and later restoration of the interfering item. Arrange with Owner to remove and later restore the interfering item to the satisfaction of the Owner, subject to approval of the project Owner; or, allow affected Owner to perform such work with his own forces. Under either arrangement, such work shall be done at Contractor's expense.

E. Take all necessary precautions to prevent fires at or adjacent to the work, buildings, and other facilities. No burning of trash or debris is permitted. If permanent fire extinguishers are used, they shall be recharged and in "new" condition when turned over to Owner.

3.05. PROTECTION OF SEWERS AND STORM DRAINS

A. Where existing sanitary sewers or storm drain systems are being replaced or interrupted, provide temporary bypass pumping or piping to maintain flow around that segment of the Work such that no back-ups occur in existing systems.

B. Maintain existing manholes, catch basins, and other utility structures in their pre-work condition. Any material or debris entering same due to the Contractor's operation shall be promptly removed.

C. Storm drains shall be protected in accordance with the details on the Contract Drawings.

3.06. PROTECTION OF WATER MAINS NEAR SEWERS

A. Where a minimum 10-foot horizontal separation or minimum 18 inch vertical separation (bottom of water pipe to top of sewer pipe) cannot be maintained between a water main and sewer line, one or more of the following remedies shall be incorporated in the work. The Contractor shall contact the Engineer if the separation requirements cannot be met and obtain approval prior to incorporating the following remedies.

1. The sewer lines shall be encased in 4,000 psi mix concrete for a length of 10 feet on either side of the water main.

2. Both the water main and sewer line shall be constructed of pressure type joints of ductile iron pipe, and shall be pressure tested to 100 psi to assure watertightness.

3. One full length of water main shall be centered over the sewer line, so that both joints will be as far from the sewer as possible.

4. Relocate water main to obtain 18 inches minimum vertical separation.

5. As directed by the Engineer or federal, state, or local authorities at no additional cost to the project Owner.

3.07. ABANDONMENT OF UTILITIES

A. Remove existing utilities to be abandoned within limits of trench excavation, or impinging on trench limits.

B. Open ends of abandoned utilities, or those scheduled for abandonment, shall be bulkheaded by brick masonry or 4,000 psi mix concrete; or by cast iron plugs or caps in small diameter water mains.

C. Abandoned sewers 36-inch diameter or larger shall be completely filled with sand or gravel or other approved material prior to bulkheading the open end(s).

D. Abandoned manholes and water valve casings shall be backfilled tograde with approved trench backfill material.

E. Frames, covers, grates, water valve casing, sections of water piping, hydrants (including standpipe and boot) valves and other items to be abandoned shall, if ordered by Owner, be salvaged for reuse and be delivered to Owner.

3.08. RESTORATION OF PROPERTY MARKERS

A. Property corner markers, boundary monuments, etc., disturbed or moved by the Contractor's operation shall be restored, in conformance with the property deed description, by a licensed land surveyor. Restoration of the property corner markers or boundary monuments shall be certified by said surveyor on a map prepared by him which shows the work accomplished. One copy of the map shall be given to the property Owner and one copy given to the project Owner.

END OF SECTION

SECTION 02222

EXCAVATING

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Excavation for site structures.

B. Excavating trenches for utilities.

C. Pipe foundations and bedding.

1.02. FIELD MEASUREMENTS

A. Provide survey benchmark and verify intended elevations for the work are as indicated.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01. PREPARATION

A. Identify required lines, levels, contours, and datum. Review subsurface report and other available site information.

B. Identify known underground, above ground, and aerial utilities. Stake and flag locations.

C. Notify Owner and utility companies.

D. Protect above- and below-grade utilities which are to remain.

E. Protect plant life, lawns, rock outcropping and other features remaining as a portion of final landscaping.

F. Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs from excavation equipment and vehicular traffic.

G. Excavations shall be in complete accordance with all details of applicable codes, rules, and regulations including all local, state, and federal regulations including the Occupational Safety and Health Administration (OSHA) Title 29 Code of Federal Regulations Part 1926, Subpart P - Excavations and Trenching Standards.

3.02. CLASSIFICATION OF EXCAVATED MATERIAL

A. Classifications of excavated materials are as follows:

1. Unclassified Excavation - “Unclassified excavation” shall include all material excavated within the authorized lines and grades prescribed in the Drawings. Unclassified excavation shall include “rock excavation” as well as “common excavation” as defined herein.

2. Common Excavation - “Common excavation” shall include all excavation except “rock excavation.” All unconsolidated and non-indurated material, rippable rock, loose rock, soft mineral matter, weathered rock or saprolite, and soft or friable shale which is removable with normal earth excavation equipment shall be considered “common excavation.” All boulders and detached pieces of solid rock or concrete or masonry less than 1 cubic yard in volume shall be classified as “common excavation.”

3. Rock Excavation - “Rock excavation” shall include all sound solid masses, layers and ledges of consolidated and indurated rock or mineral matter of such hardness, durability and/or texture that it is not rippable or cannot be excavated with normal earth excavation equipment. Should a conflict arise as to the classification of excavation as either “common” or “rock,” the following test shall be used in the appropriate determination:

   a. Where practicable, a late model tractor mounted hydraulic ripper equipped with a one digging point of standard manufacturer’s design adequately sized for use with and propelled by a crawler-type tractor rated between 210 and 240 net fly-wheel horsepower, operating in low gear, shall be utilized. Should the suspect material not be effectively loosened or broken down by ripping in a single pass with the aforementioned ripper, the material shall be classified as “rock.”

   b. In situations where interbedded strata of “common excavation” material and “rock excavation” material are encountered in the same excavation, the individual classification of those materials shall be made on an average percentage basis of the occurrence of those materials as measured in stratigraphic sections and as approved by the Engineer.

   c. When rock is encountered in excavations, it shall be removed by jackhammering or any other method suitable and safe considering the proximity of existing utilities or facilities.

3.03. EXCAVATING

A. Underpin adjacent structures which may be damaged by excavation work, including utilities and pipe chases.

B. Excavate subsoil required to accommodate building foundations, slabs-on-grade, paving, and site structures.

C. Machine-slope banks to angle of repose or less, until shored.

D. Excavation cut not to interfere with normal 45-degree bearing splay of foundation. Undercutting of excavation faces will not be permitted.

E. Grade top perimeter of excavation to prevent surface water from draining into excavation.

F. Hand trim excavation to required undisturbed subgrade. Remove loose matter.

G. Remove lumped subsoil, boulders, and rock under 1 cubic yard, measured by volume. Refill voids with Mix “C” concrete or compacted gravel/crushed stone.

H. Notify Engineer of unexpected subsurface conditions, or of questionable soils encountered at required subgrade elevations, and discontinue work in area until notified to resume operations.

I. Should the Contractor, through negligence or otherwise carry his excavation below the designated subgrade, Mix ”C” concrete or such other materials as may be approved by the Engineer, shall be furnished and placed as backfill in sufficient quantities to reestablish the designated subgrade surface. Granular material used for backfilling shall be spread and compacted in conformance with the requirements of Sections 02223, Backfilling, and 02228, Compaction. The cost of this refilling operation, including any tests associated therewith, shall be borne by Contractor.

J. Stockpile excavated material in area designated on-site and remove excess material not being reused, from site.

3.04. DISPOSAL OF MATERIAL

A. All excavated material except reusable topsoil or reusable fill shall be classified as surplus material and disposed of off-site unless Owner designates an on-site location.

B. Reuse of excavated material as on-site fill shall conform with Section 02223, Backfilling.

C. Make all arrangements for disposal sites unless the Owner designates special locations. All expenses for disposal shall be borne by the Contractor. Bidders shall carefully investigate all aspects of surplus material disposing operations.

D. Prior to depositing surplus material at any off-site location, obtain a written agreement between Contractor and the owner of the property on which the disposal of the material is proposed. The agreement shall state that the owner of the property gives permission for the Contractor to enter and deposit material of a particular classification on the owner’s property at no expense to the project Owner, and shall include any other conditions pertinent to the situation as agreed upon by each party. The owner of the property is responsible for all risks associated with the surplus material. The project Owner is not liable for damages associated with the surplus material. The agreement shall be reviewed with and approved by the Owner prior to depositing surplus material at any off-site location.

3.05. FIELD QUALITY CONTROL

A. Provide for visual inspection of bearing surfaces.

3.06. PROTECTION

A. Protect excavations by methods required to prevent cave-in or loose soil from falling into excavation.

B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

C. Exposed subgrade surfaces shall remain undisturbed, drained, and maintained as uniform, plane areas, shaped to receive the foundation components of the building or structure.

END OF SECTION

SECTION 02223

BACKFILLING

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Site filling and backfilling.

B. Fill under slabs-on-grade and paving.

C. Classification of materials.

D. Backfilling trenches for utilities.

E. Consolidation and compaction.

1.02. REFERENCES

A. ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates

B. ASTM D1556 - Density of Soil in Place by Sand-Cone Method

C. ASTM D1557 - Laboratory Compaction of Soil Using Modified Effort

D. ASTM D2922 - Density of Soil in Place by Nuclear Methods

E. ASTM D3017 - Water Content of Soil in Place by Nuclear Methods

1.03. SUBMITTALS

A. Granular Materials

1. Granular materials required for filling, backfilling, subbase and other purposes shall be as shown on the Drawings. Prior to bidding, prospective contractors shall familiarize themselves with the available quantities of approved on-site and off-site materials.

2. For each on-site or off-site material proposed, notify the Engineer of the source of the material and furnish to the Engineer for approval a certified gradation analysis (ASTM C136) and a Modified Compaction Test (ASTM D1557) at least 10 days prior to date of anticipated use of such material that has been tested within the last 6 months.

3. The Engineer reserves the right to inspect proposed source of off-site granular material and to order such tests of the materials as he deems necessary to ascertain its quality and graduation of particle size. The Contractor shall, at his own expense, engage an approved testing laboratory to perform such test, and submit certified test results to the Engineer. If similar tests of the material from a particular source were performed previously (within 6 months), submit results of these tests to the Engineer for consideration.

4. No granular materials shall be used on this project for fill, backfill, subbase, or other purpose until approval is obtained from the Engineer, and only material from approved sources shall be used.

PART 2 PRODUCTS

2.01. ON-SITE MATERIALS

A. Type A, Excavated Material - Material under this classification shall be derived solely from excavations necessary to construct the project to the lines and grades specified. If the excavated material on-site is approved for reuse and is suitable, it shall be used for filling or backfilling purposes. If he so elects, the Contractor may, at his own expense, substitute other types of material in place of Type A material, provided such substitution is approved in advance by the Engineer. All replaced or surplus material shall be disposed of as directed by the Engineer and Owner.

2.02. OFF-SITE MATERIALS

A. Within the following specifications where grain size distribution requires a maximum of 10 percent or less material capable of passing the #200 mesh sieve, the percentage of material finer (than the #200 sieve) by weight shall be determined by wet screening in accordance with ASTM D1140. It is the intent of the specifications to allow the use of granular materials from local suppliers. Material specifications shall conform to the requirements of the New York State Department of Transportation, (NYSDOT) and shall conform to the latest NYSDOT Standard Specification.

B. No gravel, sand, crushed stone or run-of-crusher material shall be used for this project until acceptance is obtained from the Engineer, and only material from approved sources shall be used. A certified sieve analysis from the supplier shall be submitted for the Engineer's acceptance prior to the use of any materials specified in Article 2.02.

C. Type B – Sand and Gravel

1. Shall be a mixture of hard, durable gravel and sand.

2. Shall be free from organic matter, trash, shale, debris, snow ice and other frozen or mechanically deleterious material.

3. NYSDOT Materials

a. Subbase course 733.0404, Type 4.

b. NYSDOT 411.01 gravel surface course meeting the following requirements:

Sieve Size	Percent Passing by Weight
2 inch	100
1/4 inch	30 – 65
No. 200	10 - 20

c. NYSDOT, Cushion Sand 703-06.

d. NYSDOT, Stone Filling, Light, 733.2102.

D. Type D - Crushed Stone

1. Shall be clean, hard, durable, angular crushed stone.

2. Shall be free from organic matter, trash, debris, snow, ice and other frozen or mechanically deleterious material.

3. Unless otherwise specified, crushed stone shall be composed of limestone pieces, chips and fines.

4. The material shall be obtained from sources which are approved by the NYSDOT, Material Designation 703-0201.

5. NYSDOT Materials

a. NYSDOT 703-0201, No. 1 stone.

b. NYSDOT 703-0201, No. 2 stone.

c. NYSDOT 703-0201, No. 3 stone.

E. Required Materials

1. Trench Backfill - NYSDOT subbase course 733.0404, Type 4

2. Pavement Subbase - NYSDOT subbase course 733.0404, Type 4.

3. Trench Special Bedding - NYSDOT 703-0201, No. 2 stone.

4. Pipe Bedding

a. NYSDOT 703-0201, No. 1 stone for greater than 4-inch diameter pipes.

b. NYSDOT, Cushion Sand 703-06 for less than 4-inch diameter pipes.

5. Structural Fill - NYSDOT subbase course 733.0404, Type 4.

6. Backfill Adjacent to Structures - NYSDOT subbase course 733.0404, Type 4.

7. Backfill Under Structures - NYSDOT 703-0201, No. 1 stone.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify fill materials to be used are acceptable.

B. Verify that all subsurface installations for the project have been inspected and are ready for backfilling.

3.02. PREPARATION

A. Generally, compact subgrade to density requirements for subsequent backfill materials.

B. Cut out soft areas of subgrade not capable of in situ compaction. Compact to density equal to or greater than requirements for subsequent backfill material.

C. Inspect spaces to be backfilled and remove all unsuitable materials including sheeting, bracing, forms and debris prior to commencing backfilling operations.

3.03. BACKFILLING

A. Backfill areas to required contours, grades and elevations with unfrozen materials.

B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.

C. Backfill material shall be inspected prior to placement and all roots, vegetation, organic matter, or other foreign debris shall be removed. Stones larger than 12 inches in any dimension shall be removed or broken. Stones shall not be allowed to form clusters with voids.

D. Backfill material shall not be placed when moisture content is more than two percent above optimum or is otherwise too high to allow proper compaction. When material is too dry for adequate compaction, water shall be added to the extent necessary.

E. Hydraulic compaction by ponding or jetting will not be permitted except in very unusual conditions and then only upon written request and demonstration of its effectiveness by the Contractor and the written acceptance by the Engineer.

F. Place and compact fill materials in continuous layers to meet appropriate requirements of Table 1 of Section 02228, Compaction.

G. Employ a placement and compaction method consistent with Section 02228, Compaction, that does not disturb or damage adjacent walls, drainage systems, dampproofing, waterproofing, protective coverings, utilities in trenches, underground conduits or tanks.

H. Maintain optimum moisture content of backfill materials to attain required compaction density.

I. Backfill against supported foundation walls. Do not backfill against unsupported foundation walls.

J. Backfill simultaneously on each side of unsupported foundation walls until supports are in place.

K. Slope grade away from building minimum 2 inches in 10 feet unless noted otherwise.

L. Rough grade all backfilled and filled areas to meet subsequent topsoiling or paving requirements. Make grade changes gradual. Blend slopes into level areas.

M. Remove surplus backfill materials from site.

N. Leave fill material stockpile areas completely free of excess fill materials.

3.04. TOLERANCES

A. Top Surface of Backfilling Under Pavement Subgrade - ±1 inch from required elevations.

B. Top Surface of Backfilling Under Paved Areas- ±1/2 inch from required elevations.

C. Top Surface of General Backfilling - ±1 inch from required elevations.

3.05. FIELD QUALITY CONTROL

A. Tests and analysis of fill material will be performed in accordance with ASTM D1557 and with Section 02228, Compaction. Compaction testing will be performed in accordance with ASTM D1556, ASTM D2922.

B. If tests indicate work does not meet specified requirements, remove work, replace, and retest at no cost to Owner.

3.06. PROTECTION OF FINISHED WORK

A. Protect finished work under provisions of Section 01500, Temporary Facilities.

B. Regrade and re-compact fills subjected to vehicular traffic.

END OF SECTION

SECTION 02225

TRENCHING

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Excavating trenches for utilities.

B. Pipe foundations and bedding.

C. Backfilling and compaction.

D. Materials.

1.02. REFERENCES

A. Standard Material Specifications for gravel, sand, crushed stone and gravel-cement mixtures published by the New York State Department of Transportation (DOT).

B. Occupational Safety and Health Administration (OSHA).

1.03. SUBMITTALS

A. Submittals for granular material and geotextiles shall be in accordance with Section 02223, Backfilling.

1.04. FIELD MEASUREMENTS

A. Verify that survey benchmark and intended elevations for the work are as indicated.

PART 2 PRODUCTS

2.01. ON-SITE MATERIALS

A. On-site material shall be in accordance with Section 02223, Backfilling.

2.02. OFF-SITE MATERIALS

A. Off-site material shall be in accordance with Section 02223, Backfilling.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify fill materials to be used are approved.

B. Verify that all subsurface excavations for the project have been compacted, approved, and are ready for backfilling (including installation of geotextiles where required).

3.02. PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Prior to start of construction, notify utility and have staked or marked all underground utilities. Utilities include water, gas, electrical, telephone, cable, storm sewer, sanitary sewers, laterals, and services. In the event such locations indicate a possible interference, or when needed to locate points of connection to existing facilities, perform exploratory excavations to determine the utilities' location and elevation. Provide the Engineer with the results of the exploratory excavations for his review. Allow the Engineer sufficient time to determine any changes required as a result of such exploratory excavations prior to start of construction.

C. Abandoned pipes and laterals shall be plugged in with 12 inches of concrete or grout for large pipes with solid brick masonry.

D. Conduct the operations such that no interruptions to the existing utility system shall occur. Where existing sanitary sewers or storm drain systems are being replaced or interrupted, provide temporary bypass pumping or temporary piping to maintain flow around the work site such that no backups occur in these sewer systems.

E. Maintain existing manholes, catch basins, and other utility structures above and below grade which are to remain in their pre-work condition. Any material or debris entering same due to the operation shall be promptly removed.

F. Protect plant life, lawns, rock outcropping, and other features remaining as a portion of final landscaping.

G. Protect control points, bench marks, existing structures, fences, sidewalks, paving, and curbs from excavation equipment and vehicular traffic. Preserve the control points provided by the Engineer throughout the life of the project, and accurately replace any such point, which is damaged or moved, at Contractor's expense.

H. Cut out soft areas of subgrade not capable of in-situ compaction. Backfill with specified pipe foundation and compact to density equal to or greater than requirements for subsequent backfill material.

I. Brace walls and slabs of structures to support surcharge loads and construction loads imposed by backfilling operations.

J. Maintain a stable, dry backfill area in accordance with Section 02141, Removal of Water.

K. Remove all water, snow, ice and debris from surfaces to accept fill materials and from the backfill material. No calcium chloride or other chemicals shall be used to prevent freezing.

L. Areas to receive compacted fill shall be graded to prevent ponding and to provide surface runoff.

M. Only approved backfill material shall be used.

N. Only approved geotextile fabrics shall be used.

O. Backfill operations shall be started at the lowest elevation in the area to be backfilled, and continue, in horizontal layers, upward to the limits specified.

P. Any crushed gravel stockpiles which have undergone excessive particle segregation shall be remixed and approved by the Engineer prior to placement.

3.03. TRENCH EXCAVATION

A. Trenches for underground piping, ductwork, drains, and similar utilities shall be excavated and maintained as shown on the Drawings and specified in this Section. Trench widths shall be held within the minimum and maximum limits shown on the Drawings. If a prefabricated, mobile shield is utilized in lieu of conventional sheeting and bracing in trenches, the bottom of the shield shall be maintained as high as possible (preferably above the spring line of the pipe) so as to prevent disturbance of the pipe foundation material and to avoid forces which would tend to pull pipe joints apart when the shield is dragged forward.

B. Gouged openings or troughs left by the shield shall be filled with additional pipe foundation material and compacted. Installation of sheeting and bracing and use of mobile shields shall be in accordance with details of applicable safety codes, rules and regulations including applicable local, state, federal, and OSHA.

C. Excavation shall be such that a flat bottom trench of allowable width is established at the required subgrade elevation for subsequent installation of pipe foundation material.

D. If indicated on the Drawings or when required as a result of unsuitable soil conditions, trench excavation shall be carried below the required subgrade and a special pipe foundation installed in conformance with the Contract Documents. In any event, operations shall result in stable trench walls and a stable base free from standing water, consistent with trench width requirements.

E. Bedrock, boulders and cobbles greater than 6 inches shall be trimmed back or removed on each side of the trench so that no rock protrudes within 6 inches of the installed pipe. Rock shall also be trimmed back across the bottom of the trench so that no rock, boulder or cobble protrudes within 4 inches of the installed pipe.

F. In general, trenches shall not be opened for more than 50 feet in advance of installed pipe. Excavation of the trench shall be fully completed at least 5 feet in advance of pipe laying operations. Trenches left open overnight shall be protected as specified within this section and to the satisfaction of the Owner and Engineer. Trenches shall not be left open overnight unless prior approval is approved from the Owner and Engineer.

3.04. EXCAVATION CLASSIFICATION

A. All material excavation shall be classified in accordance with Section 02222, Excavating.

3.05. UNAUTHORIZED EXCAVATION

A. The Contractor shall not be entitled to additional compensation for unauthorized excavations carried beyond or below the lines and subgrades prescribed in the Contract Documents. The Contractor shall refill such unauthorized excavations at his own expense, and in conformance with the following provisions:

B. Should the Contractor, through negligence or for reasons of his own, carry excavations below the designated subgrade, backfill in accordance with Section 02223, Backfilling, in sufficient quantities to reestablish the designated subgrade surface. Granular material used for backfilling shall be spread and compacted. The cost of tests associated with this refilling operation shall be borne by the Contractor.

C. If the maximum widths of pipe trenches are exceeded, the installed pipes shall be fully cradled using the specified bedding material at the Contractor's expense.

D. Excavation below subgrade which is ordered by the Engineer because the normal subgrade has been disturbed by the Contractor's operations shall be considered as unauthorized excavation.

3.06. MAINTENANCE OF EXCAVATIONS

A. All excavations shall be properly and legally maintained while they are open and exposed. Sufficient and suitable barricades, warning lights, flood lights, signs, etc., to protect life and property shall be installed and maintained at all times until the excavation has been backfilled and graded to a safe and satisfactory condition. All signs, markers, barricades shall conform to the requirements of the Manual of Uniform Traffic Control Devices. All barricades, signs and markers shall be reflectorized.

B. To maintain traffic and safety, temporary plating over trenches consisting of steel plates shall be used to temporarily bridge trench excavations. Plates shall be of size and positioned to provide adequate bearing at plate edges, shall be securely anchored, and shall be fitted in place in a manner to minimize noise when crossed by traffic. Plates shall be of sufficient thickness to safely carry heavy traffic without detrimental deflection; however, unless otherwise specified, the minimum thickness of plates shall be 1-inch.

C. Plate edges exposed to traffic shall be feathered with asphalt mix as part of trench excavation work. Work includes surveillance and adjustment of plating over trenches which shall be provided by the Contractor during non-working hours, weekends, and holidays.

3.07. PIPE FOUNDATIONS

A. All pipes, fittings, or specials which are to be installed in the open trench excavation shall be properly bedded in, and uniformly supported on pipe foundations of the various types as specified and shown on the Drawings. Flat-bottom trenches of required width shall be excavated to the necessary depth shown on the Drawings and maintained in accordance with this section prior to installing the foundation. Trenches shall be dewatered and all work performed in a dry trench.

B. Bedding material shall be spread in maximum of 6-inch layers to the midpoint of the pipe and each layer shall be compacted until the required total depth of the bedding has been built up. Compaction methods include hand tamping with T-bars, flat heads, shovel slicing, as well as mechanical compactors. The Contractor shall perform his bedding operations with care to maintain line and grade.

C. The pipe foundation above the midpoint of the pipe shall be spread and compacted in 12-inch layers to 12 inches above the top of the pipe. When PVC, plastic or polyethylene pipe is used, do not compact directly over pipe until the depth of backfill has reached 2 feet above the top of the pipe.

D. Type I - Normal Soil Conditions - Unless shown otherwise in the Drawings, all pipe shall be supported on Type I foundation. The trench shall be excavated 4 to 8 inches deeper than the bottom of the pipe, depending on the pipe's diameter. Acceptable bedding as described in the Contract Specifications shall be furnished, placed and compacted in the trench for its full width such that, after the pipe has been uniformly bedded in this material, the required minimum depth of material remains between pipe and undisturbed trench bottom. Suitable holes shall be provided in the trench bottom to permit adequate bedding of bells, couplings, or similar projections. The bedding shall extend upward to a point 12 inches over the top of the pipe. Minimum width of pipe foundation shall be outside diameter of pipe plus 2 feet 0 inches.

E. Type II - Moderately Unstable Soil Conditions - When specifically called for on the Drawings, or when ordered by the Engineer, the pipe shall be supported on Type II foundation. The foundation shall be installed where a suitable supporting soil or rock stratum occurs within 2 feet, more or less of the bottom of the pipe. The trench shall be excavated to the depth necessary to reach the suitable supporting stratum. Install a reinforcing geotextile in accordance with Section 02223, Backfilling, followed by trench special bedding which is then furnished and placed in the trench for its full width. The material shall be spread in 12-inch layers and each layer shall be compacted. Trench special bedding shall extend from the supporting stratum up to an elevation 4, 6 or 8 inches below the bottom of the pipe depending upon the pipe diameter. The bedding material shall then be installed in accordance with Type I pipe foundation requirements. In the event an underground pipe is shown under a base slab (12 inches thick or greater), the pipe shall be encased in concrete for its entire length under the slab in accordance with details shown on the Drawings.

F. Type III - Reinforced Concrete Encasement - When specifically called for on the Drawings, or when ordered by the Engineer, the pipe shall be supported on Type III foundation. The trench shall be excavated to a depth below the bottom of the pipe to provide the cover indicated in the pipe encasement detail. Install steel reinforcement and then the excavated space shall be filled, and the entire pipe encased in concrete such that the minimum concrete encasement at any point around the outside barrel of the pipe complies with the minimum cover requirements shown in the encasement detail. The pipe shall be stabilized to prevent flotation during concrete encasement. Concrete mix, formwork, reinforcing, curing, etc., shall be in accordance with the requirements of Division 3 specifications using Mix A or B concrete. Freshly placed concrete shall be maintained free from groundwater and no trench backfill shall be placed until initial concrete set has taken place, but not less than 3 hours after completion of concrete encasement operations. Backfill to a depth of 12 inches over top of concrete before beginning compaction with mechanical equipment.

G. Unless otherwise shown on the Drawings, the minimum total finished cover over the top of the pipe barrel of all pressure pipe shall be 4 feet.

3.08. GENERAL BACKFILLING REQUIREMENTS

A. Follow requirements of Sections 02223, Backfilling and 02228, Compaction.

B. Backfilling shall be started as soon as practicable and after structures or pipe installations have been completed and inspected, concrete has acquired a suitable degree of strength, and subgrade waterproofing materials have been in place for at least 48 hours. Backfilling shall be carried on expeditiously thereafter. Backfill shall be started at the lowest section of the area to be backfilled. Natural drainage shall not be obstructed at any time.

C. Backfill spaces shall be inspected prior to backfilling operations and all unsuitable materials, including sheeting, bracing forms and debris, shall be removed. No backfill shall be placed against foundation walls on structural members unless they are properly shored and braced or of sufficient strengths to withstand lateral soil pressures.

D. No backfill material shall be placed on frozen ground nor shall the material itself be frozen or contain frozen soil fragments when placed. No calcium chloride or other chemicals shall be added to prevent freezing. Material incorporated in the backfilling operation which is not in satisfactory condition shall be subject to rejection and removal at the Contractor's expense.

E. If the Contractor fails to stockpile and protect on-site excavated material acceptable for backfill, then the Contractor shall provide an equal quantity of acceptable off-site material at no expense to Owner.

F. Remove surplus backfill material from site.

3.09. PIPE TRENCH BACKFILL

A. Pipe foundations, to a depth of 1 foot above the pipe, shall be placed in 12-inch layers and compacted by approved mechanical methods to ensure firm bedding and side support. Refer to Section 02228, Compaction, for density requirements. For plastic or polyethylene pipe materials, do not compact directly over pipe until the 2 feet of cover has been installed.

B. The remainder of the trench shall be backfilled and consolidated in accordance with Section 02228, Compaction, with backfill material placed in layers not exceeding 12 inches thick and each layer compacted by a backhoe mounted hydraulic or vibratory tamper, up to 4 feet under pavement (below top of subgrade). The upper 4 feet shall be compacted using hand-guided or small self-propelled vibratory or static rollers or pads in layers not exceeding 6 inches in thickness.

3.10. PERIODIC CLEAN-UP AND BASIC RESTORATION

A. When work involves installation of sewers, drains, water mains, manholes, underground structures, or other disturbances of existing features in or across streets, rights-of-way, easements or private property, the Contractor shall (as the work progresses) promptly backfill, compact, grade and otherwise restore the disturbed area to a basic condition which will permit resumption of pedestrian or vehicular traffic and any other critical activity or function consistent with the original use of the land. The requirements for temporary paving of streets, walks, and driveways are specified elsewhere. Unsightly mounds of earth, large stones, boulders and debris shall be removed so that the site presents a neat appearance.

B. Perform clean-up work on a regular basis and as frequently as required. Basic site restoration in a particular area shall be accomplished immediately following the installation or completion of the required facilities in that area. Furthermore, such work shall also be accomplished if partially completed facilities must remain incomplete for some time period due to unforeseen circumstances.

C. Upon failure of the Contractor to perform periodic clean-up and basic restoration of the site to the Engineer's satisfaction, the Owner may, upon five days prior written notice to the Contractor, without prejudice to any other rights to remedies of the Owner, cause such work for which the Contractor is responsible to be accomplished to the extent deemed necessary by the Engineer, and all costs resulting therefrom shall be charged to the Contractor and deducted from the amounts of money that may be due him.

3.11. TOLERANCES

A. Reference Section 02223, Backfilling.

3.12. FIELD QUALITY CONTROL

A. Tests and analysis of fill material will be performed in accordance with Section 02223, Backfilling.

B. Compaction testing will be performed in accordance with Section 02228, Compaction.

3.13. PROTECTION OF FINISHED WORK

A. Protect finished work under provisions of Section 01500, Temporary Facilities.

B. Re-grade and re-compact disturbed fill areas subjected to vehicular traffic.

END OF SECTION

SECTION 02228

COMPACTION

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Compaction requirements and test methods.

B. Compact all subgrades, foundations, embankments, trench backfills, filled and backfilled material as specified.

1.02. REFERENCES

A. ASTM D698 - Laboratory Compaction of Soil Using Standard Effort

B. ASTM D1556 - Density of Soil in Place by the Sand-Cone Method

C. ASTM D1557 - Laboratory Compaction of Soil Using Modified Effort

D. ASTM D2922 - Density of Soil in Place by Nuclear Methods

E. ASTM D3017 - Water Content of Soil in Place by Nuclear Methods

1.03. SUBMITTAL

A. Submit in writing a description of the equipment and methods proposed to be used for compaction.

1.04. QUALITY ASSURANCE

A. The Contractor shall adopt compaction methods which will produce the degree of compaction specified herein, prevent subsequent settlement, and provide adequate support for the surface treatment, pavement, structure and piping to be placed thereon, or therein, without damage to the new or existing facilities.

B. The natural subgrade for all footing, mats, slabs-on-grade for structures or pipes shall consist of firm undisturbed natural soil, at the grades shown on the Drawings.

C. After excavation to subgrade is completed, the subgrade shall be compacted if it consists of loose granular soil or if its surface is disturbed by the teeth of excavating equipment.

1. This compaction shall be limited to that required to compact loose surface material and shall be terminated in the event that it causes disturbance to underlying fine-grained soils, as revealed by weaving or deflection of the subgrade under the compaction equipment.

2. If the subgrade soils consist of saturated fine or silty sands, silts, or clay or varved clays, no compaction shall be applied.

PART 2 PRODUCTS

2.01. MATERIALS

A. Materials to be compacted shall be as specified in Section 02223, Backfilling.

PART 3 EXECUTION

3.01. EXAMINATION

A. Examine spaces to be filled beforehand and remove all unsuitable materials and debris including sheeting, forms, trash, stumps, plant life, etc.

B. Inspect backfill and fill materials beforehand and remove all roots, vegetation, organic matter, or other foreign debris. Stones larger than 12 inches in any dimension shall also be removed or broken into smaller pieces.

C. No backfill or fill material shall be placed on frozen ground nor shall the material itself be frozen or contain frozen soil fragments.

D. Spaces to be filled shall be free from standing water so that placement and compaction of the fill materials can be accomplished in “dry” conditions.

3.02. PREPARATION

A. Brace walls and slabs of structures to support surcharge loads and construction loads imposed by compaction operations.

B. Proof-roll all subgrade surfaces to accept fill material.

C. Each layer of fill shall be compacted to the specified density the same day it is placed.

1. The moisture content of backfill or fill material shall be adjusted, if necessary to achieve the required degree of compaction.

D. Compact each lift in accordance with Table 1.

E. Match compaction equipment and methods to the material and location being compacted in order to obtain specified compaction, with consideration of the following guidelines:

1. Rubber-tired rollers are preferred for most areas to prevent bridging of softer materials.
2. Double smooth drum rollers may be used provided that careful inspection can prevent bridging.
3. Compaction roller should be lighter in weight than proof-rolling equipment, with a minimum compaction force of 350 lbs. per linear inch (PLI).
4. Vibratory compaction is preferred for dry, granular materials.
5. Hand compaction equipment such as impact rammers, plate or small drum vibrators, or pneumatic buttonhead compactors should be used in confined areas.

6. Hydraulic compaction by ponding or jetting will not be permitted except in unusual conditions, and then only upon written approval by the Engineer and after a demonstration of effectiveness.

7. Backhoe-mounted hydraulic or vibratory tampers are preferred for compaction of backfill in trenches under pavements over 4 feet in depth. The upper 4 feet shall be compacted as detailed above or with hand-guided or self-propelled vibratory compactors or static roller.

8. For plastic pipelines (HDPE, PVC, PE, or PB), do not compact directly over center of pipe until backfill has reached 2 feet above top of pipe.

TABLE 1

COMPACTION REQUIREMENTS

Construction Element	Maximum Compaction Layer Thickness (inches)	ASTM	Minimum Compaction
I. STRUCTURES*			
a. Fill beneath foundation elements and under slabs-on- grade - hand-guided compaction	6	D1557	95%
Fill beneath foundation elements and under slabs-on- grade - self-propelled or tractor-drawn compaction	8	D1557	95%
b. Fill around structures and above footings	12	D1557	95%
II. TRENCHES**			
a. Fill under pipelines and pipe bedding	8	D1557	95%
b. Pipe sidefills and top 4-feet of pipe backfill under pavements	12	D1557	93%
c. Backfill below 4-feet under pavement	12	D1557	90%
d. Backfill under lawns, gardens and cultivated fields	12	D1557	90%
e. All other trenches***	12	D698	85%
III. EMBANKMENTS AND FILLS			
a. Fill under streets, parking lots, and other paved areas	12	D1557	92%
b. Embankments not supporting pavement or structures	12	D1557	90%
c. Rough site grading	12	D698	85%

*Where structural loads are carried by piles, caissons or other deep foundations, minimum compaction may be reduced to 92 percent.
** The first 1 foot above non-plastic pipelines shall have a compacted thickness of 12 inches.
*** For cross-country pipelines, lifts may be compacted with a backhoe bucket or other means, and slightly mounded at the surface provided that regrading is performed within the guarantee period.

3.03. FIELD QUALITY CONTROL

A. Material Testing

1. The Engineer reserves the right to order testing of materials at any time during the work. The Contractor shall provide testing at no additional cost to the Owner.

2. Testing shall be performed in accordance with this section and the General Contract Conditions.

3. The Contractor shall aid the Engineer in obtaining representative material samples to be used in testing.

4. For each material which does not meet specifications, the Contractor shall reimburse the Owner for the cost of the test and shall supply an equal quantity of acceptable material, at no additional compensation.

5. The Contractor shall anticipate these tests and incorporate the time and effort into procedure.

B. Compaction Testing

1. The Engineer reserves the right to order the qualified independent testing laboratory to conduct in-place density tests of compacted lifts.

2. Testing shall be conducted for every 200 cubic yards of fill or backfill, or every 100 linear feet of trench backfill placed. Tests are required for each lift of fill or backfill placed.

3. The Contractor shall dig test holes and provide access to all backfill areas at no additional compensation when requested by the Engineer.

4. For each test which does not meet specifications, the Contractor shall retest at his cost. If the retest does not meet specifications, the Contractor shall replace and recompact material to the specifications at no additional cost to the Owner.

5. The Contractor shall anticipate these tests and incorporate the time and effort into procedures.

6. Nuclear moisture density testing by “probe” methods will be acceptable for compacted layers not exceeding 12 inches in thickness.

a. Nuclear “backscatter” methods will be acceptable only for testing asphalt paving layers not in excess of 3 inches in thickness.

b. Only certified personnel will conduct nuclear testing.

c. If the nuclear method is utilized, the results shall be checked by at least one in-place density test method described above.

C. Unacceptable Stockpiled Material - Stockpiled material may be tested according to material testing materials.

D. Alternate Methods of Compaction - The Contractor may employ alternate methods of compaction if the desired degree of compaction can be successfully demonstrated tothe Engineer's satisfaction.

E. Select Material - Onsite

1. Any onsite material may be used for select fill material provided it meets all the requirements of the equivalent off-site material.

2. No onsite material shall be used without prior approval of the Engineer.

F. Systematic Compaction - Compaction shall be done systematically, and no consideration shall be given to incidental coverage due to construction vehicle traffic.

3.04. PROTECTION

A. Prior to terminating work for the day, the final layer of compacted fill, after compaction, shall be rolled with a smooth-wheel roller if necessary to eliminate ridges of soil left by tractors or equipment used for compaction or installing the material.

B. As backfill progresses, the surface shall be graded so as to drain off during incidence of rain such that no ponding of water shall occur on the surface of the fill.

C. The Contractor shall not place a layer of fill on snow, ice or soil that was permitted to freeze prior to compaction.

1. These unsatisfactory materials shall be removed prior to fill placement.

END OF SECTION

SECTION 02510

ASPHALT CONCRETE PAVING

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Asphalt paving; top course, binder, and base course.

B. Driveways and parking areas.

C. Compaction.

D. Tolerances.

E. Field quality control.

1.02. REFERENCES

A. New York State Department of Transportation (NYSDOT) Standard Specifications, dated January 2, 1990.

B. NYSDOT - Manual of Uniform Traffic Control Devices.

1.03. PERFORMANCE REQUIREMENTS

A. Paving and repaving accomplished under this contract shall meet the finished grades, elevations and profiles shown on the Drawings.

1. Where pavement replacement is being accomplished, match the sectional profiles of the existing pavement unless otherwise stated herein or shown on the Drawings.

B. All thicknesses of pavement courses described herein or shown on the Drawings are after completion of compaction.

1.04. SUBMITTALS

A. Submit under provisions of Contract General and Supplemental Conditions.

B. Submit certification of plant job mix formulas that have been approved by the NYSDOT.

1.05. QUALITY ASSURANCE

A. Perform work in accordance with the NYSDOT Standard Specifications, dated January 2, 1990, as amended to date and as they apply to the following:

1. Materials and batch plant requirements.

2. Construction procedures except as modified herein.

3. Weather and seasonal limitations except as modified herein.

B. Paving work shall be performed by a qualified paving contractor or subcontractor acceptable to the Owner and Engineer.

1.06. ENVIRONMENTAL LIMITATIONS

A. Weather and Seasonal Limitations - Asphalt concrete and bituminous surface treatments shall not be placed on wet surfaces or when it is raining or when conditions prevent the proper handling, compacting or finishing of the asphalt concrete or when the surface temperature is less than specified in the following table:

Nominal Compacted Lift Thickness	Surface Temperature Minimum (Note 1)	Seasonal Limits
3" or greater	40° F	None
Greater than 1" but less than 3"	45° F	Notes 2 and 3
0.1" or less	50° F	Notes 2 and 3
Bituminous surface treatments (Note 3)	70° F or greater	Note 4

Notes:

1. All temperatures shall be measured on the surfaces (lay glass thermometer on surface and read after temperature has stabilized) where the paving is to be placed and the controlling temperature shall be the average of three temperature readings taken at locations ±25 feet apart.

2. Top course shall be placed only during the period of May 1 to October 15 in all counties except Dutchess, Orange, Rockland, Putnam, Westchester, Nassau, Suffolk, and the City of New York in which top course shall be placed only during the period of April 1 to November 15. In addition, when top course is placed between September 15 and November 15, not less than two rollers shall be furnished and operated by the Contractor.

3. Surface treatments shall be placed during the period of May 1 up to and including the first Saturday after Labor Day.

4. The ambient temperature shall be not less than 50 degrees F in the shade and not more than 95 degrees F.

5. Bituminous paving mixtures for curbs, driveways, sidewalks, gutters and other incidental construction shall be placed on surfaces having a temperature of 45 degrees F or greater. Installation of these items is not subject to seasonal limitations.

6. When work is halted because of weather conditions, limited tonnage enroute to the project may be placed, if permitted, and the mixture is within the temperature requirements.

1.07. COORDINATION

A. Coordinate field work including maintenance of traffic, access to private driveways, and emergency vehicle access.

1.08. SCHEDULING

A. Schedule the paving operations such that all paving necessary to provide safe and adequate maintenance and protection of traffic or for protection of previously laid courses is completed within the weather and seasonal limitations.

1. Such scheduling shall include expediting construction operations to permit paving before the seasonal limitations or by limiting the length of work to that which can be completed before the seasonal shutdown.

2. The cost of scheduling and sequencing of work to conform with the seasonal limitations shall be reflected in the bid prices for the related contract items.

1.10. MAINTENANCE

A. The Contractor shall maintain driving surfaces, free of ruts and potholes, for maintenance of traffic until temporary paving or permanent paving is installed.

1. All temporary paving and pavement replacement shall be maintained in a safe, drivable condition until the pavement wearing course is installed.

2. All subgrade, subbase and base courses shall also be maintained in their specific finish condition prior to placement of the next course.

B. If the Contractor fails to complete the necessary paving operations prior to weather and seasonal limitations, all temporary materials and work which become necessary as a result of such failure, such as the lowering or shimming of castings and protrusions, drainage of the roadway, providing acceptable rideability, and other work needed for the adequate maintenance and protection of traffic until paving operations can be completed the following paving season, shall be at the Contractor's expense.

C. For a period of one year after issuance of the Certificate of Substantial Completion, the Contractor shall promptly patch, maintain, repair, and/or replace any pavement that settles or becomes damaged due to settlement or defective materials or workmanship.

1. Areas to be repaired shall be cut out in a square or rectangular shape to the depth matching the top course.

2. The vertical face of asphalt to be painted with asphalt emulsion prior to placing the asphalt concrete.

3. If more than top course depth of 1-1/2-inch settlement has occurred, the pavement shall be removed to the subbase and subbase and/or binder and base course restored to proper grade before restoration of the wearing course.

4. The centerline finished grade, in any case, shall be as shown on the Contract Drawings.

PART 2 PRODUCTS

2.01. ASPHALT

A. All asphalt pavement courses shall be hot mix asphalt pavement conforming to material requirements of the following:

1. Top Course - New York State Item No. 402.128302, 12 mm F1 hot mix asphalt.

2. Binder Course - New York State Item No. 402.198902, 19 mm F9 hot mix asphalt.

3. Pavement Subbase - NYSDOT subbase course 433.0404, Type 4.

4. Tack Coat - New York State Item No. 407.0103, tack coat, emulsified asphalt.

PART 3 EXECUTION

3.01. EXAMINATION

A. Permanent restoration of pavements shall not begin until 30 days after trench or structure backfill has been completed in accordance with the applicable specifications or until testing of the installed utility has been completed in accordance with the specifications (whichever is the longest period of time after completion of trench or structural backfill).

1. Completion of backfill shall include compaction tests to ascertain compliance with degree of compaction required as described in Section 02228, Compaction.

a. Verify base conditions

b. Verify that compacted subgrade is dry and ready to support paving.

c. Verify gradients and elevations of base are correct.

B. If painted traffic markings on the pavement are to be interrupted by the new pavement replacement, they are to be restored using an approved traffic paint.

C. Driveway and Parking Areas

1. Driveways and parking areas that are disturbed or damaged by the Contractor's operations shall be restored equal to a new condition.

2. Driveway or parking area aprons which do not meet the elevation of the edge of new road pavement installed under this project shall be adjusted to meet the new pavement at a slope not to exceed 1 inch per foot with top course material of the new pavement, so that the apron conforms to the elevation of the road pavement at each location.

3. New driveways or parking areas shall be constructed as described herein and as shown on the Drawings.

3.02. PREPARATION

A. Where project consists of reconstructing existing streets, lower valve boxes and existing manholes to subgrade level by removing frame and cover and brick masonry.

1. Cover valve boxes and manholes with steel plates and locate with measured ties.

2. After constructing the subbases and pavement courses, and prior to placing the final top course, recover valve boxes and manholes and raise to finished grade.

B. All existing and new manholes, frames and covers, valve boxes, curb boxes, etc., shall be raised or lowered to be 1/2 inch below the new pavement grade.

1. No manhole covers or valve box covers shall be covered with paving material, or be exposed in a depression in the pavement greater than 1/2 inch.

C. Catch basin frames and grates shall be raised or lowered to be 1 inch below the new pavement finished grade.

D. Pavement Cuts

1. Pavement cuts for final pavement replacement shall be made as described herein and in Section 02112, Pavement Cutting.

2. Pavement cuts shall be made parallel to the centerline of the trench, shall be located a minimum of 12 inches outside the backfilled trench on undisturbed subgrade and shall be in a straight line for minimum length of 100 feet between manholes or between those stations where changes in direction of the installed piping were made.

3. Where a full street width overlay is to be installed the cutbacks may follow the backfilled trench alignment.

4. Loose, torn, cut, marked up or damaged pavement outside the cutback areas shall be removed and replaced at the Contractor's expense and match the proposed permanent paving.

5. Pavement cuts in driveways shall be cut back 12 inches and made in a straight alignment perpendicular or parallel to the driveway and for its full width.

6. Pavement cuts in parking areas shall be cut back 12 inches and made in a straight alignment parallel to the centerline of trench.

E. Preparation of Existing Surfaces

1. Prior to placing of asphalt concrete, the existing pavement surfaces shall be cleaned including brooming, mechanical sweeping, and flushing with water such that no dust or foreign material remains on the existing surface and in accordance with NYSDOT Specification "401-3.07 Conditioning of Existing Surface" and "633 3.01 Cleaning Existing Pavement and/or Shoulders."

2. After cleaning of surface, all unsealed or inadequately sealed cracks and joints shall be cleaned with compressed air and then sealed as required under NYSDOT Specification "633-3.02 Cleaning, Sealing and Filling Joints and Cracks."

3. Prior to placing of asphalt concrete, vertical faces of existing pavement, structures, curbs and gutters shall receive a tack coat as described in NYSDOT Specification "407 Tack Coat." Curbs and gutter faces to be sprayed only to the extent to be covered by the asphalt concrete.

F. All new pavement where meeting existing pavement shall be butted up against a vertical face in the existing pavement.

1. This vertical face to be cut to the depth of the new pavement.

2. Where the new pavement is an overlay, the beginning and end of the top course shall be similarly butted against a vertical face.

3. The existing pavement shall be removed for a minimum length of 2 feet, as measured parallel to the direction of paving, or greater if required to eliminate any noticeable bump or to provide adequate drainage away from structures, and to the width of new pavement.

G. Removal of Existing Pavement

1. Where shown on the Contract Drawings, the Contractor shall remove a portion of an existing pavement including Portland cement concrete paving, asphalt concrete pavement, or to remove an asphalt concrete overlay pavement from a Portland cement concrete pavement base course, to the limits and profile specified by grinding, milling, or planing methods.

2. This process shall yield a base upon which a final pavement course will be applied.

3. The Contractor shall employ equipment especially designed and manufactured for the grinding, milling or planing of pavements.

4. In general, grinding machines are designed for removing and profiling Portland Cement concrete pavement surfaces while milling and planing machines are designed for the removing of asphalt concrete pavement surfaces.

H. The resulting ground, milled or planed surface shall be thoroughly cleaned and free from dust, loose pavement material or other material.

1. The surface shall be free from gouges, large cracks and unsound, soft or broken-up areas.

2. Gouges shall be made level and true by the use of a trueing and leveling course of asphalt concrete if allowed by the Engineer.

3. Cracks greater than 1/4-inch shall be cleaned and filled in accordance with Article 3.02.

4. Unsound, soft or broken-up areas shall be excavated and repaired in accordance with Section 02576, Pavement Patching, of these specifications.

3.03. PREPARATION - TACK COAT

A. Apply tack coat in accordance with manufacturer's instructions

1. Tack coat temperature to be not less than 120 degrees F.

2. The tack coat shall be applied no more than four hours prior to paving of the asphalt concrete course.

a. No traffic will be allowed on the freshly applied tack coat.

B. Apply tack coat to contact surfaces of curbs, gutters, and existing vertical surfaces.

3.04. PREPARATION - RESET MANHOLE FRAMES

A. Prior to placing wearing (top) course, make final adjustments of manhole frames, catch basin frames, valve boxes and any other utility structures located in the pavement in relation to finished grade.

1. Manhole frames, valve boxes, etc. to set 1/2 inch below finished grade and parallel to finished crown.

2. Catch basin frames to set 1 inch below finished grade and parallel to finished crown.

a. Bevel slope of wearing course (for 6-inch width) around catch basin frame.

3.05. INSTALLATION

A. Install work in accordance with NYSDOT standards.

B. Place asphalt within four hours of applying tack coat.

C. Compact pavement by rolling. Do not displace or extrude pavement from position. Hand compact with vibratory pans and hand tamps in area inaccessible to rolling equipment.

D. Develop rolling with consecutive passes to achieve even and smooth finish, without roller marks.

3.06. PLACING AND COMPACTING

A. Placing mix in an appropriate ambient temperature and on a surface sufficiently warm to minimize the risk of excessive cooling before completion of rolling is of paramount importance. Holding the aggregate particles in place is solely the function of the film of asphalt. The asphalt cannot perform this function properly if the mix is too cool when rolled.

1. A thin course compresses very little under the roller and, as it cools quickly, it must be rolled as soon as possible.

2. The Contractor shall supply sufficient number of rollers to perform the required compaction while asphalt concrete is still hot and in a workable condition and coordinate speed of paver with rollers such that the degree of compaction required is obtained.

3. A high degree of densification is not the goal with this type of mix -- the aim is firm seating and contact of the aggregate particles.

4. One or two coverages (see Table 1) with a steel-wheeled roller weighing 8 to 10 tons is sufficient. Additional rolling may be excessive, causing a break in the bond of asphalt between aggregate particles, particularly after the mix has cooled.

5. When overtaken by sudden storms, the Engineer may permit work to continue up to the amount which may be in transit from the plant at the time, provided the mixture is within temperature limits specified.

B. Paving (NYSDOT) - All asphalt concrete shall be installed using self-powered units in accordance with the NYSDOT Specification “401-3.05 Bituminous Pavers and 401-3.11 Spreading and Finishing", except that the sixth paragraph of 401-3.11 beginning with the words “If there are less than 1500 square yards. . .” is deleted and the following substituted:

1. A self-powered paving unit shall be provided except where hand methods are permitted by the Engineer in small areas or areas inaccessible to a paving unit. For such areas, the mixture shall be dumped, spread, screened and compacted to give the required section and compaction thickness.

2. Surface Treatment (NYSDOT) - Bituminous surface treatment to be constructed in accordance with NYSDOT “Section 410 Bituminous Surface Treatment - Single Course”, Paragraphs 410-1 through 410-3.01 G.

C. Compaction - Asphalt concrete shall be compacted in accordance with NYSDOT Specification “401-3.12 Compaction and 401-3.13 Joints” using either option as follows:

1. Option A - Tandem roller (static or vibratory) 8 to 10 ton size.

2. Option B - Vibratory compaction.

D. The required number of passes for either vibratory or static rollers, listed in Table 1, are minimum and may be increased by the Engineer. One pass shall be defined as one movement of the roller over any point of the pavement in either direction. Static roller passes shall continue until all ruts, ridges, roller marks or other irregularities are removed from the surface. The Engineer may alter the compaction procedures for small areas where the specified procedures are not practical.

TABLE 1
REQUIRED NUMBER OF PASSES (MINIMUM)

Pavement Courses	Vibratory Roller		Steel-Wheel Tandem Finish Roller
	Vibrating Passes[1]	Static Passes[2]	Static Passes
Base (Open Graded Each Lift)	4	2	5
Base (Dense Graded)	4	2	5
Binder (Dense Graded)	4	Not Required	5
Top (Dense Graded All Types)	2	Not Required	2

[1] The required number of vibrating passes shall be reduced by one half (1/2) for dual vibrating drum rollers when the drums are tandem and are both in the vibrating mode.
[2] The required number of static passes may be completed by the vibratory roller operating in the static mode.

E. Unless otherwise directed by the Engineer, vibratory rollers having pneumatic drive wheels shall compact the longitudinal joint by using one of the pneumatic drive wheels to overlap the joint in two passes with the drum operating static. Unless otherwise directed by the Engineer, dual vibrating drum rollers shall compact the joint by overlapping the joints in two passes with both drums operating static.

F. To prevent adhesion of the mixture to the drum(s), the drum(s) shall be kept properly moistened with water, or water mixed with small quantities of detergent or other Department approved materials. If required to prevent pneumatic tire pickup, the pneumatic drive wheels may be coated with a fine mist spray of fuel oil or other similar material. In all instances, the surface of the pavement shall be protected from drippings of fuel oil or any other solvents used in pavings, compaction or cleaning operations.

G. If the Engineer determines that unsatisfactory compaction is being obtained or damage to highway components and/or adjacent property is occurring using vibratory compaction equipment, the Contractor shall immediately cease using this equipment and proceed with the work in accordance with the conventional static compaction procedures at no additional cost.

The Contractor should note that if he elects to use vibratory compaction equipment, he assumes full responsibility for the cost of repairing all damage that may occur to highway components and adjacent property or underground utilities.

3.07. DRIVEWAYS AND PARKING AREAS

A. Paving materials, type of paving, depth of various courses, etc., shall be as shown on the Drawings.

1. The driveways and parking areas shall be cut back 12 inches from outside disturbed or damaged areas as described above and in Section 02112, Pavement Cutting.

2. The work shall include proper compaction of any necessary subbase, base course and paving courses, in accordance with Section 02228, Compaction.

3.08. TOLERANCES

A. Surface Tolerance - The pavement surface shall be constructed to a 1/4-inch tolerance. If, in the opinion of the Engineer, the pavement surface is not being constructed or has not been constructed to this tolerance based upon visual observation or upon riding quality, he may test the surface with a 16-foot straight edge (furnished by the Contractor) 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.

1. Variations exceeding 1/4-inch shall be satisfactorily corrected or the pavement relayed at no additional cost as ordered by the Engineer.

B. Thickness Tolerance - The thickness indicated for each of the various courses of bituminous pavement is the nominal thickness. The pavement shall be so constructed that the final compacted thickness is as near to the nominal thickness as is practical, and within the tolerances specified below.

1. Material which is part of a trueing or leveling course or shim course will not be considered in pavement thickness determinations.

2. A tolerance not to exceed 1/4-inch from the nominal thickness required for the course specified under one pay item will be acceptable where the required nominal thickness is 4 inches or less. A tolerance not to exceed 1/2-inch from the nominal thickness required for the course or courses specified under one pay item will be acceptable where the required nominal thickness is over 4 inches. In addition, the sum total thickness of all bituminous mixture courses shall not vary from the total of the nominal thickness indicated on the plans by more than 1/4 inch where the total nominal thickness is 4 inches or less; or more than 1/2-inch where the total nominal thickness is over 4 inches but not more than 8 inches; and by not more than 5/8-inch where the total nominal thickness is more than 8 inches.

3.09. FIELD QUALITY CONTROL

A. The required degree of compaction for wearing or top courses and shim course is a finished product having not more than 7 percent air voids.

B. The Engineer reserves the right to order testing of materials at any time during the work. The Contractor shall provide testing at no additional cost to the Owner.

3.10. PROTECTION

A. Any pavement, constructed or reconstructed, which is subsequently damaged due to activity of work under this contract, shall be removed and replaced by the Contractor at no additional cost to the Owner.

B. Protect pavement from vehicular traffic until compaction is completed.

END OF SECTION

SECTION 02576

PAVEMENT PATCHING

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Bituminous pavement patching.

B. Compaction.

C. Testing.

1.02. REFERENCES

A. New York State Department of Transportation Standard Specifications dated January 2, 1990.

B. NYSDOT - Manual of Uniform Traffic Devices.

1.03. SUBMITTALS

A. Refer to Section 02510, Asphalt Paving.

1.04. ENVIRONMENTAL LIMITATIONS

A. Patching to be performed only when temperature and weather meet the requirements as described in Section 02510, Asphalt Paving.

1.05. SCHEDULING

A. Schedule patching work in coordination with local authorities having jurisdiction over the site.

PART 2 PRODUCTS

2.01. MATERIALS

A. Refer to Section 02223, Backfilling for pavement backfill and subgrade requirements.

B. Refer to the paving details on the Contract Drawings for description of bituminous material for patching.

1. Patches over 2 inches deep use a combination of courses of binder and wearing course as approved by the Engineer.

C. Provide asphalt emulsion for tack coating of existing edges of patch.

PART 3 EXECUTION

3.01. EXAMINATION

A. All bituminous pavement patching shall be done with asphalt concrete material matching existing pavement.

3.02. PREPARATION

A. Prior to all patching, the affected area shall be cut out as per Section 02112, Pavement Cutting, in a rectangular or square shaped manner.

1. Cutting and removal of existing material to extend 12 inches outside the affected area.

2. Two sides of the area shall be at right angles to the direction of traffic.

3. All material within the cut-out area to be removed down to a firm subgrade and disposed offsite as surplus material.

4. The surface area to be cleaned of all partially weathered or disturbed material and compacted to provide a clean hard foundation and clean interface between patch and existing pavement.

3.03. INSTALLATION

A. Subbase shall be brought to grade with specified base material.

1. For bituminous patching a tack coat shall be applied to the vertical faces of the existing pavement prior to placing asphalt material. Refer to Section 02510, Asphalt Paving.

B. A bituminous (asphalt concrete) patch shall then be applied to a depth equal to the original bituminous material, but not less than two courses of 1-1/2 inches each (material to be placed against the edges of the hole first).

1. Avoid pulling material from center of patch to the edges, instead if more material is needed at the edge, it should be deposited there, and the excess raked away.

2. Sufficient material should be used to ensure that after compaction, the patched surface will be at the correct grade and slope, slightly higher than the adjacent pavement, and not below the adjacent pavement.

3. Each course shall be thoroughly compacted by the use of mechanical tampers, vibratory plate compactors and hand tampers for small areas and roller for large areas.

3.04. TOLERANCES

A. After completion of patching, the Contractor shall check smoothness with straight edge or stringline. Deviations of 1/8 inch or more shall be corrected.

END OF SECTION

SECTION 02698

UNDERGROUND PROCESS PIPING

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Underground process pressure and gravity flow piping, fittings and specials located outside structures.

B. Miscellaneous appurtenances.

C. Shop tests.

D. Installation.

E. Testing.

1.03. REFERENCES

American National Standards Institute (ANSI). American Water Works Association (AWWA). American Society for Testing Materials (ASTM).

A. Ductile Iron and Gray Iron Pipe

ANSI A21.4/AWWA C104	Cement-Mortar Lining for Ductile Iron and Gray Iron Pipe and Fittings for Water
ANSI A21.4/AWWA C105	Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids
ANSI A21.10/AWWA C110	Ductile Iron and Gray Iron Fittings, 3-inch through 48-inch, for Water and Other Liquids
ANSI A21.11/AWWA C111	Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings
ANSI A21.50/AWWA C150	Thickness Design of Ductile Iron Pipes
ANSI A21.51/AWWA C151	Ductile Iron Pipe Centrifugally Cast in Metal Molds and Sand Lined Molds for Water and Other Liquids
AWWA C600	Installation of Ductile Iron Water Mains and Their Appurtenances
ASTM A126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings

1.04. SUBMITTALS

A. Submit under provisions of Section 01300, Submittals.

B. Product Data - Provide data, indicating conformance to ASTM/AWWA codes, pipe material, sizes, class, dimension, joint type and accessories.

C. Manufacturer’s Installation Instructions - Indicate special procedures required to install products specified.

D. Results of shop tests, if required.

E. Manufacturer's Certification - Certify that (products) meet or exceed specified requirements.

F. Submit certifications for iron and steel products in accordance with AIS requirements and the General Contract Conditions.

G. Submit applicable warranties.

H. Current welder certificates of welders that are utilized in fabrication, erection and installation. Each welder shall have a permanent identifying mark next to each weld.

1.05. PROJECT RECORD DOCUMENTS

A. Submit documents under provisions of Section 01700, Closeout and Record Documents.

B. Submit marked-up record drawings including record location of pipe connections, valves, cleanouts, bends, tees, manholes, and rim and invert elevations. Invert elevations to be of the pipe invert at a point where the pipe enters or exits a structure.

C. Identify and locate on record drawings existing utilities and services not indicated in the Contract Documents but discovered during construction.

1.06. REGULATORY REQUIREMENTS

A. Conform to the requirements of regulatory agencies having jurisdiction over the work.

1.07. FIELD MEASUREMENTS

A. Prior to start of construction, verify the field measurements and elevations that existing conditions, structures, and elevations are as shown on Drawings. Notify Engineer of specific differences.

B. Prior to start of construction, where ordered, verify by exploratory excavations that existing underground utility locations and elevations are as shown on Drawings prior to installation of crossing pipes or to confirm location and elevation of uncharted utilities. Notify Engineer of location and elevation and allow Engineer sufficient time to determine any changes required as a result of such exploratory excavation, prior to start of construction.

C. Where connections are to be made to existing pipes, confirm the type of material and the outside dimensions of pipes.

1.08. TEST REQUIREMENTS

A. Requirements for pressure testing of pressure process piping installed under this section are described in the Table at the end of this Section.

1.09. COORDINATION

A. Coordinate work under provisions of the General Contract Conditions.

B. Coordinate the work with Owner where affecting operation of existing structures and treatment facilities.

PART 2 PRODUCTS

2.01. GENERAL

A. All products included in this section shall conform to the requirements of the standard specifications referenced herein.

B. Pipe material, pipe class and pipe sizes shall be furnished and installed as specified within this section.

C. Underground process piping shall be installed as shown on the Drawings.

2.02. MATERIALS

A. Ductile Iron Pipe (DIP)

1. All DIP shall be restrained joint and flanged pipe conforming to ANSI/AWWA C151/ANSI A21.51.

2. DIP shall be rated for a minimum water pressure of 150 psi and be minimum Class 52.

3. All DIP shall have an interior double cement lining and bituminous seal coat in accordance with ANSI/AWWA 21.4/C104, latest date. DIP shall have an external bituminous seal coat. All seal coats to be a minimum of 1 mil thick. Linings shall consist of cement mortar, centrifugally applied, and shall not be less than 1/8 inch for 6 inch pipe.

4. Fittings 24 inches in diameter and less shall conform to ANSI/AWWA C110/A21.10 (full body fittings) or ANSI/AWWA C153/A21.53 (Class 350 compact fittings). Fittings greater than 24-inch diameter shall conform to ANSI/AWWA C110/A21.10 (full body fittings).

5. Joints - Unless otherwise specified in this section, fittings shall be furnished with mechanical joints and pipe shall be furnished with restrained push-on joints conforming to ANSI/AWWA C111/A21.11. The type of joint shall meet the following standard requirements:

a. Push-On Joint - Rubber gasket joint conforming to AWWA Standard C111.

b. Mechanical Joint - Gasketed and bolted joint of the stuffing box type conforming to AWWA Standard C111.

c. Flanged Joint - Flanged and bolted joint conforming to AWWA Standard C110.

d. Restrained Push-On Joint - Rubber gasket restrained joint conforming to AWWA Standard C111.

e. Restrained push-on joints shall permit the following maximum pipe deflection:

Pipe Size	Maximum Deflection (Degrees)
4” through 12”	5.0
14” through 18”	3.0
20” through 36”	1.5
42” thru 54”	0.5

f. Restrained joint pipe shall be TR Flex as manufactured by U.S. Pipe and Foundry, Flex-Ring Joint pipe as manufactured by American Ductile Iron Pipe Company, Snap-Lok restrained joint piping by Griffin Pipe Products, or equal; where necessary, Megalugs Series as manufactured by EBAA Iron Inc. are allowable.

6. All pipe and fittings used for process piping shall be lined and coated as specified in Article 2.04.

2.03. PIPE ACCESSORIES

A. Fittings

1. Same materials, class, coatings and linings as pipe unless under Article 2.02 it was specifically described otherwise.

2. Fittings molded or formed to suit pipe size and end design and in required tee, bends, elbow, couplings, adapters, and other configurations.

B. Pipe openings in existing walls shall be precast or core drilled and completely sealed against water seepage with a mechanical type seal consisting of interlocking synthetic rubber links and nuts with pressure plates wider at ends, the seal shall be a link seal manufactured by Thunderline Corporation, Wayne, MI, or equal.

C. Wall fittings capable of accepting pipe joints being used shall be installed in new construction.

2.04. LININGS AND COATINGS

A. Inside of pipe (ductile iron and steel pipe only, except piping for air service)

1. Pipe and fittings for all potable and non-potable water lines shall be double cement lined and seal coated in accordance with ANSI 21.4/AWWA C104.

2. Pipe and fittings for all other process piping shall be lined with asphaltic material, minimum 1 mil thick, in accordance with ANSI/AWWA C104/A21.4.

B. Outside of Pipe

1. Underground Pipe

a. Ductile Iron Pipe - All underground and concrete-encased ductile iron pipe and fittings shall be asphalt coated in accordance with AWWA C104.

2. All ductile iron and steel pipe and fittings shall be factory primed and coated.

2.05. IDENTIFICATION

A. Each pipe length and fitting shall be clearly marked with:

1. Manufacturer’s name and trademark.

2. Nominal pipe size and class.

3. Material designation.

2.06. ENCASEMENT

A. Where shown on the Drawings, pipes shall be encased in 4,000 psi mix concrete.

B. Where shown on the Drawings or as specified by the Engineer, pipes shall be encased in a polyethylene sleeve. Damage to wrapping during pipe laying or backfilling operations shall be repaired with additional sleeve material and adhesive tape.

2.07. COUPLINGS

A. Couplings to be ductile iron fittings, Smith Blair Model 441, or equal with stainless steel bolts and nuts. The couplings shall receive two coats of coal tar epoxy paint on all exterior surfaces prior to installation.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify that trench cut, excavated base and pipe bedding are ready to receive pipe and that excavations, pipe, and bedding dimensions and elevations are as shown on Drawings.

B. All pipe or fittings which have been damaged in transit or which are obviously deformed or refinished in any way shall be rejected, marked, and removed from the site of the work.

1. Any pipe or fitting which Engineer suspects is improper for the job shall be temporarily rejected, marked, and set aside for subsequent investigation to determine its conformity with the specifications.

2. All pipe fittings and specials shall be carefully inspected in the field before lowering into the trench. Cracked, broken, warped, out-of-round, damaged pipe joints including damaged pipe lining or coatings or specials, as determined by Engineer, shall be culled out and not installed.

a. Such rejected pipe shall be clearly tagged in such manner as not to deface or damage it, and the pipe shall then be removed from the job site by Contractor at his own expense.

3.02. PREPARATION

A. Contractor shall have on the job site with each pipe laying crew, all the proper tools, gauges, pipe cutters, lubricants, etc. to handle, cut and join the pipe.

B. Flat-bottom trenches of required width shall be excavated to the necessary depth as required and maintained in accordance with Section 02225, Trenching.

C. Prior to installing the pipe foundation material, trenches shall have all water removed and all work performed in a dry trench.

D. All pipes, fittings and specials which are to be installed in the open trench excavation shall be properly bedded in and uniformly supported on pipe foundations of the type specified in Section 02225, Trenching, and shown on the Drawings.

1. Stones 2 inches and larger shall be removed from the bearing surface of the pipe foundations.

E. Pipe foundation bedding material shall be spread in maximum 8-inch layers and each layer shall be compacted up to the spring line of the pipe.

F. Compaction methods include hand tamping with T-bars, flat heads, shovel slicing as well as mechanical compactors.

G. Contractor shall perform his bedding operations with care to maintain line and grades.

H. Suitable holes or depressions shall be provided in the pipe bedding to permit adequate bedding of bells, couplings, or similar pipe projections.

3.03. LINES AND GRADES

A. Contractor shall furnish all labor, materials, surveying instruments, and tools to establish and maintain all lines and grades.

1. Contractor shall have personnel on duty or on standby call, at all times, who are qualified to check line and grade of pipe lines as they are installed.

B. During construction, Contractor shall provide Engineer, at this request, all reasonable and necessary materials, opportunities, and assistance for setting stakes and making measurements, including the furnishing of one or two rodmen or chainmen as needed at intermittent times.

C. Contractor shall carefully preserve bench marks, reference points and stakes established by Engineer or Owner, and in case of willful or careless destruction by his own operations he will be charged with the resulting expense to reestablish such destroyed control data and shall be responsible for any mistakes or delay that may be caused by the unnecessary loss or disturbance of such control data.

D. Contractor may use laser equipment to assist in setting the pipe provided he can demonstrate satisfactory skill in its use.

E. The use of string levels, hand levels, carpenter's levels or other relatively crude devices for transferring grade or setting pipe are not to be permitted.

3.04. TOLERANCES

A. Pipes shall be laid to the lines and grades shown on the Drawings.

B. Minimum depth of cover shall be maintained as shown on the Drawings or as described herein.

3.05. INSTALLATION

A. Installation of ductile iron pipe or plastic pipe to be in conformance with ASTM C600 or ASTM D2774, respectively, except as modified in this section or referenced sections or as shown on the Drawings.

B. Contractor shall furnish slings, straps and/or approved devices to provide satisfactory support of the pipe when it is lifted.

1. Transportation from storage areas to the trench shall be restricted to operations that can cause no damage to the pipe or lining or castings.

C. The pipe shall not be dropped from trucks onto the ground or into the trench.

D. Each pipe section shall be placed into position in the trench on the pipe bedding in such manner and by such means required to cause no injury to the pipe, persons or to any property.

E. The method of laying and jointing the pipe shall be in accordance with the recommendations of the manufacturer.

1. Each pipe shall be aligned with that already in place, forced home completely with horizontal axial movement and held securely in position.

2. The bell of each pipe length to be laid in the same direction the installation is proceeding.

F. At the joints, enough depth and width shall be provided to permit the pipe layer to reach entirely around the pipe so that the joints may be made in accordance with the manufacturer's recommendations.

1. Mechanical-type joints shall be tightened within the AWWA recommended torque range.

G. Pipes, fittings, and specials shall be firmly bedded in the pipe foundation and shall have full bearing throughout their entire length, which shall be accomplished by combination of shaping the bedding and adequately compacting the pipe bedding and backfill under and around the pipe to the spring line of the pipe.

1. The remaining backfill shall be installed in accordance with Sections 02225, Trenching and 02228, Compaction.

H. Pipe laid in normal trench excavation shall not be laid on wood blocking.

I. Mechanical joint and flange connections shall be installed in accordance with the manufacturer’s recommended procedure. Mechanical joint adapters and flanges shall be centered and aligned to the mating component before assembling and tightening bolts. In no case shall mechanical joint gland or flange bolts be used to draw the connection into alignment. Bolt threads shall be lubricated, and flat washers should be used under the nuts. Bolts shall be evenly tightened according to the tightening pattern and torque step recommendations of the manufacturer. At least one hour after initial assembly, flange connections shall be retightened following the tightening pattern and torque step recommendation of the manufacturer. The final tightening torque shall be as recommended by the manufacturer.

J. Backfill material within 12 inches of the pipe shall be free of stones greater than 2 inches in any dimension.

K. Unless otherwise shown on the Drawings, the minimum total finished cover over the top of the pipe barrel of all pipe shall be 3 feet.

L. Refer to Section 02225, Trenching, for other installation guidelines and requirement.

M. To deflect a pipe joint, first join the pipe in the proper manner and deflect the pipe within the allowable deflection recommended by the manufacturer.

N. Installation of AWWA C905 and/or AWWA C909 pipe shall be in accordance with AWWA 605.

3.06. BRACING AND BLOCKING

A. Restrained joint piping shall be used for all underground piping, except for storm drains and gravity sanitary sewer, unless non-restrained piping is specifically permitted by the Contract Drawings.

B. All bends, tees, crosses, plugs, etc., in non-restrained joint piping systems designed to operate at 20.0 psi or greater shall be braced and blocked with wood and then anchored with concrete thrust blocks so that there will be no movement of the pipe in the joints due to the internal or external pressures.

C. The concrete shall be placed around the fittings and completely fill the space between the fittings and walls of the trench, from 6 inches below the fittings of pipe to 12 inches above the fittings and in accordance with the dimensions and details shown on the Contract Drawings.

D. The anchor concrete shall be so placed that the bell and spigot joints or other joints may be tightened, if necessary.

E. Steel ties shall be used only where shown on the Drawings.

F. Prior to installation of the concrete anchor, Contractor shall wrap all fittings with a minimum of 8 mil thick polyethylene.

G. Cast-in-place concrete used in constructing concrete thrust blocks shall be in accordance with Section 03300, Cast-in-Place Concrete.

H. Blocking and bracing is not required for restrained joint piping.

3.07. TEMPORARY PLUGGING

A. At all times when pipe laying is not actually in progress, the open ends of the pipes shall be closed temporarily with pipe plugs or by other means such that there is no possibility of any water or foreign material entering the line.

B. If water is in the trench when work is resumed, the plugs shall not be removed until the water has been removed and work can proceed in a dry stable trench.

3.08. CLEANING PIPELINE

A. At the conclusion of the work, Contractor shall thoroughly clean all new pipes by flushing with water or other means to remove all dirt, stones, pieces of wood, etc., which may have entered during the construction period.

1. If, after this cleaning, any obstructions remain, they shall be corrected to the satisfaction of Engineer.

2. Pipes shall be flushed at a minimum rate of 2.5 feet per second for a suitable duration.

B. Where required Contractor shall use mechanical methods to clean pipes when flushing does not remove all obstructions or material.

3.09. TESTING

A. The following testing procedures shall be utilized, as required:

1. Force mains and pressure sewer systems shall be tested as follows:

a. 2-hour test at 50 psi.

B. Any section of pipe that fails the pressure or leakage test shall be dug up and replaced or permanently repaired as approved by Engineer.

1. The replaced or repaired section shall be retested.

(continued)

3.10. PIPING SCHEDULE

Pipe No.	Identity	Predominant Size(s) (Inches)	Pipe Material	Schedule or Class	Joints	Test Procedure
UH	Force Main	24	DIP	Class 52	Restrained mechanical	2 hours at 50 psi
TA	Force Main	24	DIP	Class 52	Restrained mechanical	2 hours at 50 psi

END OF SECTION

SECTION 02734

SANITARY SEWER MANHOLES

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Factory design and manufacture of manhole sections and accessories.

B. Quality assurance and control.

C. Field installation of manholes.

D. Connection of sewer pipe.

E. Construction of bench walls and flow channels.

F. Installation of frames and covers.

1.02. REFERENCES

ASTM A48	Gray Iron Castings
ASTM A536	Ductile Iron Castings
ASTM C62	Building Brick
ASTM C90	Hollow Load Bearing Concrete Masonry Units
ASTM C144	Aggregate for Masonry Mortar
ASTM C150	Portland Cement
ASTM C207	Hydrated Lime for Masonry Purposes
ASTM C443	Joints for Circular Concrete Sewer and Culvert Pipe Using Rubber Gaskets
ASTM C478	Precast Reinforced Concrete Manhole Sections
ASTM C923	Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals

1.03. SUBMITTALS

A. Submit shop drawings of typical manufactured wall sections and bases proposed for this project, including joint design and related details for field assembly. Include certification of conformance with Contract Documents and the appropriate ASTM Specification.

B. Submit shop drawings of typical cast iron frames and covers proposed for this project.

C. Anti-Flotation Design - Structure shall be designed by a registered Professional Engineer.

1. Design shall include anti-flotation collar to withstand flotation under full hydrostatic head with a 1.25 factor of safety for all manholes.

a. 4-Foot Inner Diameter - Flotation collar shall be minimum of 4-inch.

b. 5-Foot Inner Diameter - Flotation collar shall be minimum of 6-inch.

c. Greater than 5-Foot Inner Diameter - Flotation collar reviewed on a case-by-case basis.

D. Submit certifications for iron and steel products in accordance with AIS requirements and Section 01300, Submittals.

1.04. QUALITY ASSURANCE

A. Precast reinforced concrete wall sections and bases for manholes shall be manufactured in a plant approved by Engineer.

B. Completed manholes shall be watertight.

1.05. QUALITY CONTROL INSPECTION

A. The quality of all materials, the process of manufacture and the finished sections shall be subject to inspection by the Engineer. Such inspection may be made at the place of manufacture, and/or at the work site after delivery. Manhole sections shall be subject to rejection if they fail to meet the specification requirements, even though sample sections may have been accepted as satisfactory at the place of manufacture. Sections rejected after delivery to the site shall be tagged and removed from the job site immediately. All sections which have been damaged after delivery will be rejected, or if already installed, shall be removed and replaced at the Contractor's expense.

B. All sections shall be inspected for general appearance, dimensions, soundness, etc. The surface shall be dense, close-textured and free of blisters, cracks, roughness, exposure of reinforcement, damaged joints, and dimensional distortions or other irregularities.

C. Frames and covers shall be manufactured true to pattern and shall be of uniform quality, free from blowholes, porosity, hard spots, shrinkage distortion or other defects. Covers shall seat uniformly in any position in the frame without rocking.

PART 2 PRODUCTS

2.01. PRECAST CONCRETE BASES

A. Design and manufacture of precast concrete bases for manholes shall conform to the requirements of this section and ASTM C478. Bases shall conform to the dimensions indicated on the Drawings, and the horizontal joint at the top of the base shall be compatible with that of the precast wall section.

B. Precast bases shall be manufactured to contain openings in the wall, of minimum size, to receive the ends of the installed sewer pipe. Openings shall be accurately positioned to conform with line and grade of the connecting sewer.

C. The top of the manhole base shall extend at least 10 inches above any pipe openings in the base.

2.02. PRECAST CONCRETE WALLS AND MANHOLES TOPS

A. Design and manufacture of precast concrete walls shall conform to the requirements of this section and ASTM C478.

B. Precast concrete walls shall be made with straight, circular pipe sections and eccentric cone sections if manhole steps are required and concentric cone sections where no steps are required. The total height of precast wall required for each manhole shall be determined in the field, and shall be such that the vertical distance between the top of the assembled precast units and the bottom of the installed cast iron manhole frame is a minimum of 4 inches and a maximum of 12 inches, to allow for grade adjustment rings.

C. If required, manhole steps shall be cast integrally with or grouted solid into the precast wall units. Lifting holes that extend completely through the manhole are not permitted in the precast units.

D. All joints in the precast wall, including the joint at the top of the base, shall be made up using either one of the following:

1. “Snap-On”-type O-ring gasket, and shall conform to ASTM C443; except that joint taper shall not exceed 3-1/2 degrees. The precast sections shall be provided with a special groove (cast into the male end) to receive and hold the gasket in position during joint assembly.

2. Two beads of butyl-type rope joint sealant material. Install to manufacturer's specifications. Barrel mating surfaces shall be clean, dry, and free from grease, oil, dirt, or organic matter to assure a proper watertight seal between seating and butyl rope material.

E. When using O-ring gaskets, the gap between sections shall be packed on the inside and outside with grout after joint assembly. The grout shall be A-H Axpandcrete by Anti-Hydro, Masterflow 713 Plus by Degussa, or Five Star® Grout by Five Star Products, Inc., or equal, and shall be troweled smooth so that no projections remain on the inside. There shall be concrete to concrete bearing between the various sections, and the gasket shall not support the weight of the section.

F. If required, precast reinforced concrete slab tops for manholes shall be manufactured in accordance with ASTM C478, except that thickness and reinforcing shall be as shown on the Drawings. Openings shall be of the proper diameter to receive the frame specified.

G. Manhole tops shall be cast with four threaded inserts to accommodate frame hold-down bolts.

2.03. MONOLITHIC CAST-IN-PLACE CONCRETE BASES

A. Cast-in-place concrete bases are not permitted, except when constructing a new manhole on existing concrete sewers.

2.04. FRAMES AND COVERS

A. Frames and covers shall be of the make, style, opening, height, weight, and other designation as specified herein and as shown on the Drawings.

B. Material shall be gray cast iron conforming to ASTM A48, Class 30; or shall be ductile cast iron conforming to ASTM A536, Grade 60-40-18.

C. Manhole frame and covers shall be H-20 load rated.

D. Unless otherwise scheduled, frames and covers shall be heavy duty, non-penetrating pickhole type of non-rocking design, and shall have machined bearing surfaces to prevent rocking and rattling under traffic loads. Covers shall have cast in, 1-1/2-inch wide, raised letters, the words "RCSD NO. 1".

E. Unless otherwise noted, all manhole covers shall be self-sealing and shall be furnished with O-ring rubber gaskets.

F. Surface finish shall be smooth and well-cleaned by shot-blasting or by some other approved method.

G. Frames and covers shall have clear opening of 30-inch diameter.

H. Rubber gasketed lids shall be installed on all manholes into which pressure sewer discharges and all meter pit manholes.

I. Acceptable manufacturers are:

1. East Jordan Iron Works; Pattern 1230A1 (cover); 1234Z (frame).

2. Neenah Foundry Company.

3. Or approved equal.

2.05. MANHOLE STEPS

A. Manhole steps are to be provided in manholes. Steps are to be cast in or grouted solid into the precast units at intervals of 12 inches. Steps shall be in conformance with OSHA requirements having drop front or equivalent. Bolted-on type are not acceptable. Manhole steps to be Neenah Casting Company R-1982F, M.A. Industries, Inc. copolymer polypropylene reinforced with 1/2-inch steel rod or equal.

2.06. GRADE RINGS

A. General - Grade adjustment for a manhole shall not exceed 12 inches.

B. Precast Concrete Grade Rings - Precast concrete grade rings for leveling units shall be manufactured in compliance with the requirements of the Specifications for Precast Reinforced Concrete Manhole Sections, ASTM C478; and shall be as thick as necessary to provide the required grade adjustment but not less than 3 inches in height. Split grade rings are unacceptable. Broken or cracked concrete grade rings will not be acceptable.

C. Rubber Grade Rings

1. Rubber grade rings (rubber adjustment riser) for leveling units shall comply with the following:

Physical Properties	Test Results	Test Method
Density	±1.098 g/cm^3	ASTM C642-90
Durometer Hardness • Molded surface • Interior surface	 75A ± 10 points 73A ± 10 points	Based on ASTM D2240
Tensile strength	1.6 MPa (232 psi) (not less than 1 MPa)	ASTM D412-87
Compression deformation • Initial deformation • Final deformation	Under 1 MPa (145 psi) 6 ±4 percent 6 ±4 percent	Based on ASTM D575
Compression set	0.4 percent (no more than 4 percent) under 1 MPa (145 psi)	Based on ASTM D395
Freeze and thaw when exposed to deicing chemicals	No loss after 50 cycles	ASTM C672-91
Coefficient of thermal expansion	1.08 x 10^{-4} mm/mm/°C (6 x 10^{-5} in/in/°F)	ASTM C531-85
Weathering (70 hours at 70 degrees C) • Hardness retained • Compressive strength retained • Tensile strength retained • Elongation retained	 100 ± 5 percent 100 ± 5 percent 100 ± 5 percent 100 ± 5 percent	ASTM D573-88

2. Rubber grade rings shall only be used in paved areas.

3. Tapered rubber grade rings shall be used to accommodate sloped paved surfaces.

2.07. CEMENT GROUT

A. Cement grout shall be non-shrink, non-metallic.

B. Use Type I cement where grout is not in contact with sewage.

C. Use Type II (sulfate resistant) where grout is in contact with sewage.

2.08. EPOXY BONDING COMPOUND

A. Provide a high modulus, low viscosity, moisture insensitive epoxy adhesive having the following characteristics:

1. Mix Ratio - 200 percent solids, two-component, mixed one part by volume component B to two parts by volume component A.

2. Ultimate Compressive Strength - 13,000 psi after cure at 73 degrees F and 50 percent relative humidity determined in accordance with ASTM D695.

3. Acceptable Manufacturers

a. Sika Corporation, Sikadur Hi-Mod.

b. A.C. Horn, Inc., Epoxtite Binder.

c. Euclid Chemical Company, 452 Epoxy System.

2.09. PIPE SEALS

A. Sanitary sewer connections between manholes and pipes shall be constructed using flexible rubber pipe to manhole connectors in accordance with ASTM C923.

B. Acceptable flexible pipe connectors include the Z-Lok gasket and the X-Cell gasket as manufactured by A-Lok Products, Inc., Kor-N-Seal connectors as manufactured by Trelleborg Pipe Seals Milford, Inc., or an approved equal.

C. All associated hardware shall be stainless steel.

D. Elastomeric waterstop gaskets are not permitted.

E. The ends of the pipe shall be accurately positioned in the openings, properly secured against movement, and the remaining annular space between the pipe wall and the base completely packed with A-H Axpandcrete by Anti-Hydro, Masterflow 713 Plus by Degussa, or Five Star® Grout by Five Star Products, Inc., or equal. Before the grout has set, the Contractor shall recheck invert elevations of the ends of the pipe, and perform any adjustments which are necessary to establish the required line and grade of the sewer.

2.10. CAST-IN-PLACE CONCRETE

A. Cast-in-place concrete used in constructing manhole bench walls shall conform to requirements of Mix "C" concrete specified in Section 03300, Cast-In-Place Concrete.

2.11. WATERPROOFING

A. The Contractor shall furnish manholes waterproofed over the entire exterior surface that will be below finished grade. The waterproofing shall not mar or interfere with the specified exterior finish for these structures. Waterproofing shall be accomplished prior to structure installation for precast sections, and shall be applied to dry surfaces under proper weather conditions.

B. Waterproofing shall consist of a two-coat application of coal tar compound as manufactured by Koppers Bitumastic Super Service Black; Tnemec Heavy Duty Black 46-449; Preco Nitoproof 600; or equal, and shall be applied according to manufacturer's specification. Total thickness of the two-coat application shall not be less than 16 mils.

C. The interior surfaces of manholes and structures shall be painted with Haze Gray Sherwin Williams Cor-Cote SC Sewer-Cote; Tnemec Series 218 MortarClad surface primer with Gray Series 446-Color Perma-Shield MCU finish coat; or equal in accordance with manufacturer’s recommendations.

2.12. INTERIOR EPOXY LINING

A. Contractor shall install a polymer epoxy spray on the interior of manholes. The spray shall be designed specifically for protection of the concrete manhole from sanitary sewer service. Properties are as listed:

1. Compressive Strength (ASTM C579) - 6800 psi.

2. Flexural Strength (ASTM C580) - 4600 psi.

3. Modulus of Elasticity (ASTM C580) - 5.5 x 10^5 psi.

4. Tensile Strength (ASTM C307) - 2500 psi.

5. Bond Strength to Dry or Damp Concrete Manhole (ASTM C478) - Concrete failure.

6. Thermal Expansion Coefficient - 3.8 x 10^{-5}.

B. Thickness shall be 60 to 125 mils. Lining shall be Sauereisen SewerGard Rotary Spray No. 210RS or equal in accordance with manufacturer's recommendations. Surface shall be high pressure washed (4,000 to 7,000 psi) and any voids filled in with Sauereisen Filler Compound No. 209 and/or Substrate Resurfacer No. F-121. All work shall be done in accordance with manufacturer's recommendations.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify that subgrade elevations for manhole bases are correct and excavation is dewatered.

B. Verify that rejected (tagged) units have been removed from the site.

3.02. PREPARATION

A. Provide foundation mat of structural fill in accordance with Section 02223, Backfilling, to support manhole base. Mat shall be 12 inches minimum depth and shall bear on sound undisturbed earth; excavate and remove subgrade material as necessary to reach sound stratum.

B. Mat diameter shall be a minimum of 2 feet greater than outside diameter of manhole base, and shall be compacted to a uniform, level surface.

3.03. INSTALLATION

A. Manholes

1. Precast base shall be accurately located and uniformly supported on the foundation mat in a level position.

2. Install subsequent wall sections, as required, in their properly oriented position. Each section shall be joined in conformance with manufacturer’s instructions, using prescribed joint gaskets or joint materials. There shall be concrete-to-concrete bearing between the various sections, and gasket material shall not support the weight of the section.

3. All precast units shall be laid-up plumb and level to form a vertical manhole structure at each location.

4. When grade adjustment exceeds 12 inches, barrel sections corresponding to the manhole diameter shall be used.

B. Pipe Seals - Connect ends of sewer pipe to manholes with flexible rubber sleeves, straps and bolts.

C. Channels and Benches

1. Construct flow channels and bench walls in bottom of manholes, shaped to follow details on the Drawings. Flow channels shall match inverts and size of pipes, creating a channel of gradual slope and curvature such that smooth, uninterrupted flow through the manhole is assured. Extend channel wall vertically up to top of highest (flowing) pipe so as to form the bench wall. Bench surface shall extend horizontally to manhole walls, with slight pitch toward flow channel.

2. Flow channels and bench walls shall be constructed of cast-in-place concrete, although half-sewer pipe sections may also be utilized to form portions of the flow, channel. All exposed concrete surfaces shall receive a steel troweled finish except horizontal surface of bench walls which shall be broom finished.

D. Grade Rings

1. Furnish and install grade rings at manhole top so as to adjust and support cast iron frame to finished grade.

2. When grade adjustment of less than 3 inches is required, rubber grade rings shall be used.

3. Joints between precast concrete grade rings for leveling units shall be made with two-bead preformed plastic sealing compound and shall be 1/2 inch thick and troweled or trimmed smooth on the inside of the manhole. In addition, the leveling units shall be sealed on the outside surface using non-shrink grout.

4. Joints between rubber grade rings and rubber precast concrete grade rings or frame shall be made with polyurethane marine sealant compound.

5. The joint between the bottom of the frame and the top of precast concrete grade rings, or the top manhole section as applicable, shall be made with preformed plastic sealing compound and shall be sealed on the outside surface using non-shrink grout.

E. Frames and Covers

1. Frames shall be firmly seated in full bed of mortar and be positioned to conform to the adjacent finished grade, or to the specific elevation shown on the Drawings.

2. Frames to be set parallel to surface slopes.

3. Covers shall seat uniformly in any position in the frame without rocking.

4. In pavements and shoulder areas, set frame 1/2 inch below finished grade.

3.04. BACKFILLING

A. Carry out backfilling operations in conformance with Division 2 specifications, being careful to provide full support under connecting pipes using compacted bedding material specified for the sewer piping.

3.05. ACCEPTANCE TESTING

A. Manholes shall be watertight. All visible leaks shall be permanently sealed in an approved manner. Repair of manhole sections using grout, either cementitious or polyurethane, is not permitted.

END OF SECTION

SECTION 02821

ASBESTOS ABATEMENT

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. The Report of Building Survey for Lead Based Paint (LBP), Asbestos Containing Materials (ACM) and PCB's in Caulking Materials included as Appendix A in the Contract Documents summarizes sampling undertaken to test for asbestos. The survey report identifies locations of asbestos-containing materials (ACM) at the Union Hill and Tallman Pump Stations owned by the Rockland County Sewer District No. 1. The report is intended to be a reference and may not be inclusive of all the hazardous materials present at the project facilities.

B. General Contractor shall provide all labor, materials, equipment, services, and incidentals necessary for safe and lawful demolition, removal, and disposal of all of ACM and associated asbestos-contaminated materials necessary to complete the project work and as specified by the Owner and Engineer. The General Contractor is also required to provide all labor, materials, equipment, services and incidentals necessary for safe and lawful demolition, removal and disposal of all material present at the project facilities that can reasonably be assumed to be ACM or associated asbestos-contaminated materials. At each building, location, or facility where ACM was identified in the survey or identified during the project, all like material belonging to the same construction assembly or serving the same purpose at the building, location, or facility is to be assumed to be ACM and is to be handled as such. The work described in this paragraph may also be referred to herein as the Asbestos Project.

C. General Contractor shall provide the services of a New York State Department of Labor (NYSDOL) Certified Project Designer to plan the scope, timing, phasing and remediation methods to be utilized on this Asbestos Project.

D. The General Contractor shall provide the services of an independent testing laboratory to perform air sampling and testing during asbestos abatement and removal work. The laboratory shall not be affiliated with the project Contractors and the asbestos removal subcontractor and shall be approved by the Engineer.

E. General Contractor shall provide the services of an Asbestos Abatement Contractor licensed by the New York State Department of Labor and employing personnel with current certifications as required to lawfully conduct the abatement work of this Asbestos Project.

F. The General Contractor is responsible for demolition, removal, and disposal of all hazardous materials. The General Contractor is responsible to coordinate demolition work and sequencing with all other Contractors, the Engineer, and the Owner.

1.02. REFERENCES

A. Appendix A – Report of Building Survey for Lead Based Pain (LBP), Asbestos Containing Materials (ACM) and PCB's in Caulking Materials for D&B Engineers and Architects, P.C., 4 West Read Oak Lane, Suite 315, White Plains, New York 10604 at Various Buildings at the Rockland County Sewage Treatment Plant, Orangeburg, New York, the Tallman Pump Station, Airmont, New York and the Union Hill Pump Station, Montbello, New York dated July 22, 2014.

B. New York State Department of Environmental Conservation (NYSDEC) 6 NYCRR

1. Part 360 Solid Waste Management Facilities.

2. Part 364 Waste Transporter Permits.

3. Part 370 Hazardous Waste Management System-General.

4. Part 371 Identification and Listing of Hazardous Wastes.

5. Part 372 Hazardous Waste Manifest System and Related Standards for Generators, Transporters and Facilities.

6. Part 373 Hazardous Waste Management Facilities.

C. Occupational Safety and Health Administration (OSHA) – Part 1926, Safety and Health Regulations for Construction, Subpart Z, Toxic and Hazardous Substances, Standard 1926.1101, Asbestos)

D. U.S. Environmental Protection Agency (USEPA)

1. National Emission Standards for Hazardous Air Pollutants; Asbestos NESHAP Revision; Final Rule.

2. Asbestos Emergency Response Act (AHERA) (40 CFR Part 763, Subpart E).

E. New York State Department of Labor (NYSDOL): Industrial Code Rule 56 (12 NYCRR Part 56).

1.03. DEFINITIONS

A. Authorized Personnel - Facility's representative and all other personnel who are authorized officials of any regulating agency, be it state, local, federal or private entity who possess legal authority for enforcement or inspection of the work.

B. Clearance Criteria - Shall be determined and established by a Certified Asbestos Project Monitor with an independent testing lab employed by the General Contractor, conforming to all standards set forth by all authorities having jurisdiction, mentioned in the references, and issue the certification of cleaning.

C. Site-Specific Variance - Relief in accordance with Section 30 of the Labor Law from specific sections of Industrial Code Rule 56 for a specific project.

D. Phase I and II - Asbestos Project phases as defined and subcategorized in ICR 56-2.

1.04. ABBREVIATIONS

A. American Society for Testing and Materials (ASTM)

B. Code of Federal Regulations (CFR)

C. New York State Department of Labor (NYSDOL)

D. National Institute for Occupational Safety and Health (NIOSH)

E. Occupational Safety and Health Administration (OSHA)

F. United States Environmental Protection Agency (USEPA)

1.05. ASBESTOS SITE-SPECIFIC VARIANCE

A. If a site-specific variance is sought, the application must be submitted by the General Contractor's NYSDOL Certified Asbestos Project Designer within 14 days after contract award. Forward the required forms to the NYSDOL for their action.

1.06. SUBMITTALS

A. Asbestos Site-Specific Variance Submittals - If a site-specific variance is sought, submit the following:

1. One copy of the completed DOSH-751 and DOSH-465 forms.

2. One copy of the NYSDOL site-specific variance decision.

B. Quality Control Submittals

1. Notification Compliance Data - Within two days after notification is sent to the regulatory agencies, submit one copy of each notice sent to each regulatory agency (USEPA and NYSDOL).

2. Asbestos Removal Company Data - Name and address of proposed asbestos removal company and abatement contractor license issued by NYSDOL.

3. Asbestos Worker Certification Data - Name and address of proposed asbestos abatement workers and licenses issued by NYSDOL.

4. Work Plan - Submit one copy of the work plan as specified within this section.

5. Waste Transporter Permit - One copy of transporter's current waste transporter permit from NYSDEC (NYS Part 364 Permit).

6. Evidence of Landfill Licensing - Landfill to be used for ACM disposal shall be licensed to receive asbestos waste by NYSDEC (NYS Part 360 Permit) and by USEPA. Out-of-state landfills shall provide licenses from local agencies having jurisdiction.

7. Negative Air Pressure Equipment - Copy of manufacturer and performance data of all units and HEPA filters used.

C. Asbestos Work Closeout Submittals

1. Waste Shipment Records and Disposal Site Receipts - Copy of waste shipment record and disposal site receipt showing that the ACM has been properly disposed.

a. Waste shipment record and disposal site receipt must be received within 35 days of the ACM waste leaving the site. If receipts are not received within the specified time period, the Engineer will notify USEPA in writing within 45 days of the ACM waste leaving the site.

D. Work Plan - At the conclusion of the pre-work conference, before the physical abatement work begins, the General Contractor shall prepare a detailed work plan.

1. The work plan shall include, but not be limited to, work procedures, types of equipment, details of equipment used, decontamination unit locations, crew size and credentials, disposal locations, and emergency procedures for fire and medical emergencies and for failure of containment barriers.

2. If a site-specific variance is sought, do not finalize the work plan until the NYSDOL decision is received.

3. The work plan shall be reviewed by the Engineer prior to the commencement of all demolition work.

1.07. CONTRACT CLOSEOUT SUBMITTALS

A. Daily Log - Submit copy of Project Monitor's daily air sample log and a copy of Asbestos Abatement Contractor's daily log.

B. Air Monitoring Data - Submit copy of air test results and chain of custody.

1.08. QUALITY ASSURANCE

A. Regulatory Requirements - Comply with the referenced standards.

B. Pre-Work Conference - Before the work of this section is scheduled to commence, a conference will be held by the Engineer at the site for the purpose of reviewing the Contract Documents, discussing requirements for the work, and reviewing the work procedures.

1. The conference shall be attended by the project Contractors, the asbestos removal subcontractor, and the testing laboratory employed by the General Contractor.

1.09. PROJECT CONDITIONS

A. In addition to the postings required by law, post the following documents at the entrance to the abatement area:

1. Copy of the printed work plan.

2. Copy of Industrial Code Rule 56.

B. Shutdown of Air Handling System - Complete the work of this section within the time limitation allowed for shutdown of the air handling system serving the work area.

1. The air handling system will not be restarted until approval of the air monitoring tests following the last cleaning.

2. If total shutdown of the system is not acceptable, follow all regulations for local isolation and provision for temporary HVAC as per NYSDOL regulations.

C. Maintain electric services to those portions of the building and remaining facility not a part of the asbestos abatement work area at all times. Follow all regulations for electric power shutdown exemptions as per NYSDOL regulations.

D. Do not obstruct any aisle or passageway so as to reduce its required width as an exit.

1.10. HEALTH AND SAFETY

A. Where in the performance of the work, workers, supervisory personnel or sub-contractors may encounter, disturb, or otherwise function in the immediate vicinity of contaminated items and materials, all personnel shall take appropriate continuous measures as necessary to protect all ancillary building occupants from the potential ACM exposure.

1. Such measures shall include the procedures and methods described herein and shall be in compliance with all applicable regulations of federal, state and local agencies.

1.11. FIRE PROTECTION, EMERGENCY EGRESS, AND SECURITY

A. Establish emergency and fire exits from the work area containment. Provide first aid kits and two full sets of protective clothing and respirators for use by qualified emergency personnel outside of the work area.

B. Provide a logbook throughout the entire term of the project. All persons who enter the regulated abatement work area or enclosure shall sign the logbook. Document any intrusion or incident in the log book.

1.12. PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

A. Workers must wear personal protective equipment for all projects as per OSHA and NYSDOL regulations. Provide respiratory protection in accordance with OSHA regulation 1910.134 and ANSI Z88.2.

B. Workers must be trained as per OSHA and NYSDOL requirements, have medical clearance, and must have recently received pulmonary function test (PFT) and respirator fit tested by a trained professional.

1. A personal air sampling program shall be in place as required by OSHA.

2. The use of respirators must also follow a complete respiratory protection program as specified by OSHA.

PART 2 PRODUCTS

2.01. DISPOSAL BAGS

A. Type - Minimum 6 mil thick, black, and preprinted with a "Caution" label.

2.02. EQUIPMENT

A. Temporary lighting, heating, hot water heating units, ground fault interrupters, and all other equipment on site shall be UL listed.

B. All electrical equipment shall be in compliance with the National Electric Code, Article 305-Temporary Wiring.

2.03. GLOVE BAGS

A. Type - Minimum 6 mil thick, clear, fire retardant polyethylene. Select glove bag sizes appropriate for the size and location of the project.

2.04. NEGATIVE AIR PRESSURE UNITS

A. Type - Local exhaust system, capable of maintaining negative air pressure within the containment, and provides for HEPA filtration of efficiency not less than 99.97 percent with 0.3-micron particles. Equip the unit with filter alarms lights and operation time meter.

2.05. PLASTIC SHEETS

A. Type - Minimum 6 mil thick, clear, fire retardant polyethylene.

2.06. RESPIRATORS

A. Complying with 29 CFR 1910.134 (OSHA).

2.07. VACUUM CLEANERS

A. Type - Vacuums equipped with HEPA filters.

PART 3 EXECUTION

3.01. ACM, PACM, AND SACM HANDLING AND REMOVAL PROCEDURES

A. Comply with the standards referenced in Part 1 of this section. Remove and properly dispose of all materials and items identified as ACM, PACM, and SACM in Pre-Demolition Asbestos and Hazardous Materials Assessment Reports(s) referenced in Article 4 of the Supplementary Conditions in accordance with this section and all applicable local, state, and federal rules and regulations.

3.02. CLEANUP PROCEDURES

A. Comply with the standards referenced in Part 1 of this section.

3.03. PROJECT AIR SAMPLING, MONITORING, AND ANALYSIS

A. Air Sampling and Analysis – The General Contractor shall provide the services of an independent testing laboratory to perform air sample monitoring during asbestos abatement and removal work. The laboratory shall not be affiliated with the project Contractors and the asbestos removal subcontractor and shall be approved by the Engineer. The laboratory shall use the methods described in standards referenced in Part 1 of this section.

1. The equipment, duration, flow rate, calibration of equipment, number and location of samples are as per ICR 56-4.

2. Air sampling technician shall be on site to observe and maintain airsampling equipment for the duration of the air sampling collection.

3. Period of time permitted between completion of air sample collection and receiptof results on the project site shall be equal or less than 48 hours.

B. If air samples collected outside the regulated work area indicate airborne fiber concentrations at or above 0.01 fibers per cubic centimeter, or the established background level, whichever is greater; work shall stop immediately for inspection of barriers and negative air ventilation systems. Clean up surfaces outside the regulated work area using HEPA filter equipped vacuums and wet cleaning methods. Work methods shall be altered to reduce fiber concentrations to acceptable levels.

C. Elevated air sample results, if any, along with background and all other air sample results shall be submitted to the Commissioner of appropriate Asbestos Control Bureau within the same business day of receipt of results.

3.04. FINAL CLEANING AND CLEARANCE PROCEDURES

A. Negative Pressure Ventilation - Negative air pressure machines if used, shall remain in continuous operation during the entire length of the project.

B. Cleaning and Visual Inspection - After first, second, third cleaning and required waiting/settling and drying periods, perform a final visual inspection.

1. Final clearance air sampling shall commence after the waiting/settling and drying time as per ICR 56 has elapsed.

C. Project Monitor Visual Inspection – The General Contractor will employ the services of a NYSDOL Certified Asbestos Project Monitor employed by an independent testing laboratory to perform visual inspection as required by ICR 56.

D. Final Clearance Air Sampling – The General Contractor will employ the services of an independent testing laboratory to perform final air sampling.

1. The laboratory shall use the methods described in standards referenced in Part 1 of this section.

2. The equipment, duration, flow rate, calibration of equipment, number, and location of samples are as per ICR 56-4.

3. If initial post-abatement (clearance air) monitoring results do not comply with the standards referenced in Part 1 of this section, the Contractor shall either re-clean or order a full set of TEM analysis.

a. Results of the TEM analysis will be conclusive, and if the results do not comply with the standards referenced in Part 1 of this section, the Contractor shall re-clean and additional full set of air samples will be collected and analyzed until the standards are met.

b. All satisfactory PCM clearance air sample results along with background air sample results, if they are greater than or equal to 0.01 fibers per cubic centimeter, shall be submitted to the Commissioner of appropriate Asbestos Control Bureau within two business days of receipt of satisfactory clearance air results.

c. All satisfactory TEM results of previously unsatisfactory PCM clearance air sample results, along with the unsatisfactory PCM results shall be submitted to the Commissioner of appropriate Asbestos Control Bureau within two business days of receipt of satisfactory clearance air results.

4. Prior to removal of isolation barriers, the Engineer at the site will receive an affidavit from the air monitoring laboratory certifying the final air samples comply with the standards referenced in Part 1 of this section.

E. Dismantling of Regulated Abatement Work Area

1. Remove all tools and equipment after proper decontamination as per Part 1 of this section.

2. Dismantle and remove each tent enclosure and air lock and any barriers only after final clearance air monitoring has been performed and satisfactory results obtained.

3. All remaining polyethylene, duct tape, expandable foam and other barrier materials shall be bagged, wrapped, containerized and labeled as asbestos waste.

4. Remove all temporary hard walled barriers from site.

5. Dismantle any remote decontamination units and plastic sheeting shall be disposed as asbestos waste.

6. Remove all waste generated to the holding area, lockable trailer or dumpster.

7. Contractor's Supervisor shall certify in writing to the Engineer that abatement work is complete and no debris/residue remains.

3.05. DISPOSAL OF ACM AND RELATED DEBRIS

A. Remove all waste generated as part of the asbestos project from the project site within 10 calendar days from the site after completion of abatement or within 1 day of the waste disposal container/trailer becomes full, whichever occurs first.

B. Transport and dispose of all the asbestos-containing waste, related debris, and wastewater to the approved disposal site.

C. All generated waste removed from the site must be documented, accounted for and disposed of in compliance with the requirements of USEPA NESHAP.

D. Comply also with the standards referenced in Part 1 of this section.

3.06. RESTORATION

A. Remove temporary decontamination facilities and restore area designated for these facilities to its original condition or better.

B. Where existing work is damaged or contaminated, restore work to its original condition or better.

C. Where existing property is damaged or contaminated, replace the property to its original condition or better.

END OF SECTION

SECTION 02833

REMOVAL AND DISPOSAL OF MATERIAL CONTAINING LEAD

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. The Limited Lead Paint Inspection and Testing Report included as Appendix A in the Contract Documents summarizes sampling undertaken on behalf of Owner. Contractor is to provide all labor, materials, equipment, services, and incidentals necessary for the removal of lead- based paints (LBP) as required to permit the safe and lawful demolition, removal and disposal of the equipment, piping, conduit and other items scheduled for demolition as shown on the Drawings or as specified. The report is intended to be a reference and other LBP may be present at the project facilities.

B. Where equipment, piping, or building components such as doors or door frames are noted to contain LBP by the report or identified during the project, it shall be assumed to be the complete piece of equipment, entire run of pipe, or complete building component.

C. Contractor is to provide all containment, environmental monitoring, laboratory testing, personnel protection, medical monitoring and other measures necessary to perform the work in accordance with all applicable federal, state and local regulations.

D. All work related to this section, including but not limited to, environmental protection, worker protection, and hazardous waste disposal, shall be in strict compliance with all applicable federal, state and local laws, codes, rules and regulations.

E. The General Contractor is responsible for demolition, removal, and disposal of all hazardous materials. The General Contractor is responsible to coordinate demolition work and sequencing with all other Contractors, the Engineer, and the Owner.

1.02. REFERENCES

A. Appendix A – Limited Lead Paint Inspection & Testing Report for Rockland County Sewer District No. 1 located at 4 Route 340, Orangeburg, NY 10962, Main Influent Pump Station prepared by Environmental Maintenance Contractors Inc, and dated December 31, 2019.

B. General Requirements

1. Except as modified by governing codes and by this specification, comply with the applicable provisions and recommendations of latest editions of the below-listed references.

2. Where the language in any of the documents referred to herein is in the form of a recommendation or suggestion, such recommendations or suggestions shall be deemed to be mandatory under this contract unless otherwise directed by the Engineer.

3. Conflicts - Conform to requirements of cited standard unless specified otherwise. In case of apparent conflict between standards, or between standards and the specifications herein, the more stringent shall apply unless otherwise directed by the Engineer.

C. The Contractor shall comply with all applicable federal, state and local regulations, standards, codes and guidelines concerning the removal and disposal of material containing lead, including, but limited to the following:

1. New York State Department of Environmental Conservation (NYSDEC) - Comply with the following Parts of 6 NYCRR:

   a. Part 360 Solid Waste Management Facilities.

   b. Part 364 Waste Transporter Permits.

   c. Part 370 Hazardous Waste Management System - General.

   d. Part 371 Identification and Listing of Hazardous Wastes.

   e. Part 372 Hazardous Waste Manifest System and Related Standards for Generators, Transporters and Facilities.

   f. Part 373 Hazardous Waste Management Facilities.

   g. Part 376 Land Disposal Restrictions.

2. New York State Department of Transportation (NYSDOT) - Comply with 49 CFR Parts 100 through 199.

3. Occupational Safety and Health Administration (OSHA) – Part 1926, Safety and Health Regulations for Construction, Subpart D, Occupational Health and Environmental Controls, Standard 1926.62, Lead.

4. Occupational Safety and Health Administration (OSHA) – Part 1910, Occupational Safety and Health Standards, Subpart Z, Toxic and Hazardous Substances, Standard 1910.1025, Lead.

5. United States Department of Housing and Urban Development (HUD) - Guidelines for Evaluation and Control of Lead Based Paint Hazards - Title Ten of Housing and Community Act of 1992.

6. United States Environmental Protection Agency (EPA)

   a. Resource Conversation and Recovery Act (RCRA) Section 3004 Hazardous and Solid Waste Amendments.

   b. Toxicity Characteristics Leaching Procedure, EPA Method 1311.

7. American Society for Testing and Materials (ASTM):

   a. E1728-99, "Standard Practice for Field Collection of Settled Dust Samples Using Wipe Sampling Methods for Lead Determination by Atomic Spectrometry Techniques."

   b. E1727-99, "Standard Practice for Field Collection of Soil Samples for Lead Determination by Atomic Spectrometry Techniques."

   c. E1792-96a, "Standard Specification for Wipe Sampling Materials for Lead in Surface Dust."

1.03. SUBMITTALS

A. Within 60 days of the Notice to Proceed, and prior to conducting any demolition or removal work at the project site, Contractor shall submit a site and location-specific work plan showing specifics of how Contractor will satisfy all applicable laws, codes, rules and regulations and the requirements of this section including:

1. Identity and qualifications of Contractor's designated competent person.

2. Engineering and work practice controls.

3. Cleaning procedures.

4. Types of equipment, including, but not limited to:

a. Respirators in compliance with 29 CFR 1910.134.

b. HEPA vacuuming equipment.

c. Collection and disposal containers.

d. Materials for creating dust control areas.

5. Emergency procedures for fire and medical emergencies.

6. Procedures for failure of containment barriers, if used.

7. Proof that Contractor has similar experience working with lead-containing paint and lead-based paint in municipal settings.

8. Employee exposure assessment to lead.

9. Physician's written opinion that the employees are fit for duty.

10. Respiratory protection program, if lead exposure will be above the PEL.

11. Results of employee blood lead and ZPP levels, if lead exposure will be above the PEL.

12. Proof of Hazardous Communication program.

13. Procedures for paint removal, containment, visible emissions monitoring, and clean-up.

14. Drawings indicating the location, size, and details of lead dust control work areas, location and details of containment and decontamination facilities

15. Proposed schedule and sequencing of lead removal activities.

16. Procedures for waste handling, testing, storage, transportation and disposal.

B. Without delay as available during conduct of the work, submit copies of all laboratory test results on wipe samples obtained for the work.

C. Without delay as available during conduct of the work, submit copies of all waste shipment records and disposal site receipts documenting proper disposal of any materials classified as hazardous.

1.04. QUALITY ASSURANCE

A. The persons performing lead abatement and their supervisor shall be personally experienced in lead abatement work and shall have been regularly employed by a company performing lead abatement work for a minimum of three years. Submit evidence documenting worker training and experience to the Engineer. The Contractor shall obtain the services of a qualified subcontractor if necessary to comply with the requirements of this section.

1. If a subcontractor is utilized to perform any of the work of this section, the requirements of this Section shall apply to the subcontractor as if specifically referred to herein and he shall comply. The Contractor's use of a subcontractor(s) shall not relieve the Contractor of full responsibility for the work to be performed.

B. Any laboratory providing services in connection with the work shall be certified by the New York State Department of Health (NYSDOH) in the analysis of lead and other heavy metals such as zinc, cadmium and chromium and submit proof of providing similar laboratory services on at least five projects in the last three years. Any such laboratory shall be accredited by the American Industrial Hygiene Association (AIHA) and certified by the Environmental Laboratory Accreditation Program (ELAP) as required by the NYSDOH. The laboratory should actively participate and show proficiency in the National Institute for Occupational Safety and Health (NIOSH) Proficiency Analytical Testing (PAT) program. The laboratory conducting worker blood analysis shall be approved by OSHA and NYSDOH. Submit evidence documenting laboratory qualifications to the Engineer.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01. COORDINATION WITH THE OWNER'S OPERATION

A. Contractor shall provide seven days written notice to the Engineer prior to the start of any paint removal work.

B. Contractor shall make every effort to establish containment areas such that they do not prohibit access by plant personnel to operating equipment.

3.02. MONITORING, TESTING, AND SAMPLING EQUIPMENT

A. Contractor shall properly calibrate and supply the instrumentation needed for the monitoring of workers including all equipment needed for its operation (e.g., generators, batteries, power cords, fuel, etc.) as required by OSHA.

B. Contractor shall use equipment that is free of loose dust and debris when brought onto each work site, and upon removal. Contractor shall vacuum using High Efficiency Particulate Air (HEPA) filtered vacuum shrouds and/or wet wipe the equipment with an approved cleaning solution to assure that it is clean prior to removal from the work site.

3.03. WASTE CONTAINERS

A. Hazardous Waste - Contractor shall provide USDOT-approved containers in accordance with 49 CFR 178 (e.g., 17H containers in the case of 55-gallon drums) of the appropriate size and type for the hazardous waste generated on the project. Use containers that are resistant to rust or corrosion (painted, if constructed of steel), that have tight fitting lids or covers, and which are water-resistant and leak proof. Provide the Engineer with a signed statement that the containers are labeled as required by applicable federal, state and local regulatory requirements.

B. Non-Hazardous Waste - Contractor shall provide all containers for non-hazardous waste. Use containers that are free of loose debris when brought on site. Containers shall be watertight and corrosion resistant.

C. Spent Solvents - Contractor shall provide all containers for spent solvents, whether the solvent is designated for reuse, or for disposal as hazardous waste, and do not mix spent solvents with spent abrasives, paint debris, water, or other waste. Containers shall be watertight and corrosion resistant.

D. Container Maintenance - Contractor shall maintain all containers in good operating condition with lids and closing mechanisms intact and operational to prevent the escape of debris, spilling of the contents, or access by unauthorized personnel and observe all labeling requirements.

3.04. CONTAINMENT

A. Contractor shall provide proper containment measures in all areas where LBP is to be removed. LBP shall be removed without damage or contamination to adjacent areas, buildings, waterways or the environment in any fashion. This shall include any water runoff from wet removal methods. Water runoff from wet removal methods shall not be discharged to plant drains.

B. Contractor shall prevent dust, paint chips, spent removal media, solvents, and other debris from entering any plant drain and shall immediately contain and clean up any materials which become deposited near or in any plant drain or come into contact with any standing or flowing water within the plant.

C. Contractor shall supply all equipment and materials needed to contain emissions, releases, waste and/or debris in accordance with OSHA standards.

D. Establish emergency and fire exits from the containment area. Provide first aid kits and two full sets of protective clothing and respirators for use by qualified emergency personnel outside of the work area.

E. Provide a logbook throughout the entire term of the project. All persons who enter or leave the containment area shall sign the logbook. Document any intrusion into the work area or other incident in the logbook.

3.05. REMOVAL OF LEAD-BASED PAINT

A. Perform removal of LBP in accordance with the approved LBP removal work plan.

1. Use procedures and equipment as required to limit occupational and environmental exposure to lead when lead-based paint is removed in accordance with referenced standards.

2. Remove lead based paint a minimum distance of 6 inches on all sides of the location proposed for cutting, burning, power tool use and/or other work that will disturb, affect or demolish the paint.

3. Limit the production and dissemination of dust as much as possible.

B. LBP shall be removed to the extent required to perform the safe and lawful removal and disposal of the equipment or piping scheduled for demolition.

1. Torch cutting, open flame burning, power tool use and/or other work which will disturb, affect or demolish lead-based paint shall be permitted only after all visible paint has been removed from the substrate surface for a minimum distance of 6 inches on all sides of the location proposed for cutting, burning, power tool use and/or other work which will disturb, affect or demolish the paint.

3.06. WORK AREA CLEAN-UP AND MAINTENANCE

A. At the end of each work day, the Contractor shall visually inspect the entire work area for dust, paint chips, spent paint removal media, solvents, and other debris that have been deposited within the work area or surrounding surfaces, water or soil. If debris from the Contractor's operations is observed outside the initial inspection limits, the limits shall be expanded to include additional areas as directed by the Engineer.

B. Contractor shall clean up all visible dust, paint chips, spent paint removal media, solvents, and other debris at the end of each work day, or more frequently as directed by the Engineer.

C. Clean all surfaces within the work area and surrounding areas at the end of each work day by wet vacuuming and/or wet wiping or washing, as directed by the Engineer. When wet vacuuming, use only vacuums that are equipped with HEPA filters. Conduct wipe sampling to verify that lead levels are below the required clearance criteria. If lead levels exceed this clearance criteria, repeat clean-up procedures as necessary until wipe sampling verifies that lead levels are below the clearance criteria.

3.07. CERTIFICATION

A. At the completion of lead-based paint removal operations, Contractor shall provide the services of a qualified laboratory to perform post-cleaning testing of surfaces within the work area and areas adjacent to the containment area to verify that lead-based dust and other debris generated by the Contractor's operations have been properly cleaned from the area. The Engineer shall be present during all wipe testing. Contractor shall submit a letter to the Engineer certifying that the work areas have been properly cleaned.

3.08. PRE-DISPOSAL TESTING

A. Prior to disposal, test the removed materials for toxicity in accordance with EPA Method 1311, Toxicity Characteristic Leaching Procedure.

B. Test results indicating a value greater than 5 ppm lead classifies the removed material as hazardous waste.

C. Removed material shall be classified according to the requirements of the receiving site and the agencies having jurisdiction.

3.09. DISPOSAL OF LEAD PAINT AND RELATED DEBRIS

A. Transport and dispose of LBP and related debris classified as hazardous waste in accordance with the standards referenced in Part 1 of this section

B. All generated waste removed from the site must be documented, accounted for and disposed of in compliance with all federal, state and local regulations.

C. In addition to any requirements of New York State, comply with all transportation and disposal requirements of the jurisdiction of the disposal site.

3.10. RESTORATION

A. Remove temporary decontamination facilities and restore the work area to its original condition or better.

B. Restore any areas outside the work area damaged or contaminated by the Contractor's operations to their original condition or better.

3.11. RECORDKEEPING REQUIREMENTS

A. Contractor shall comply with all federal, state and local regulations regarding record keeping requirements concerning the handling and disposal of LBP and related debris.

B. Contractor shall document the transportation and disposal of LBP and related debris using four copy manifests. Each manifest shall be numbered and shall document the contents of each waste container and shall record the chain of custody from the time the materials are removed from the site to the time of proper disposal.

1. One copy of each manifest shall be provided to the Engineer immediately upon removal of any waste container from the site.

2. One copy of each manifest shall be maintained by the Contractor in his office at the site and shall be produced upon demand by the Owner, NYSDEC, NYSDOH, or any other entity having jurisdiction. Manifests shall be turned over to the Owner at the completion of the project.

C. Contractor shall submit to the Engineer a Certificate of Disposal within 30 days of the completion of disposal of lead-containing waste. The certificate shall include:

1. The identity of the recycling or disposal facility, by name, address, and EPA identification number.

2. The identity of the lead waste affected by the Certificate of Disposal including reference to the manifest number for the shipment.

3. A statement certifying the fact of disposal of the identified lead waste, including the date(s) of disposal and identifying the disposal process used.

4. A copy of the relevant shipment manifest(s) shall be attached to each Certificate of Disposal.

END OF SECTION

SECTION 02980

SITE REHABILITATION

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Site rehabilitation of lawns, existing cultivated or landscape items such as trees, shrubs, hedges, saplings, vines, ground cover vegetation, gardens, etc.

B. Topsoil, fertilizer, seeding, mulching and planting.

C. Site modifications and development to meet new conditions.

D. Removal and disposal of all excess materials, equipment, trash and debris used for, or resulting from, the work included in this section.

1.02. REFERENCES

A. The American Association of Nurserymen Standards - ANSI Standard 2-60.1, “Nursery Stock”.

B. Soil Conservation District of the Department of Agriculture.

1.03. QUALITY ASSURANCE

A. Areas and Features to be Restored

1. All areas, including natural features occurring thereon, which are damaged or disturbed by the Contractor’s operations, shall be restored, repaired or replaced to the same or superior condition which existed prior to construction or as modified herein or as shown on the Drawings.

2. Artificial features shall be restored equal to a new condition or as modified herein or as shown on the Drawings.

1.04. SUBMITTALS

A. Submit under provisions of Section 01300, Submittals.

B. Submit the source nursery for all plantings.

C. Topsoil - Submit sieve analysis and characteristics of topsoil as listed in Part 2.

D. Seed mixture data.

1.05. QUALIFICATIONS

A. All planting material to be furnished from a nursery which meets the requirements of the American Association of Nurserymen.

1.06. PACKING AND SHIPPING

A. All seed furnished for this project shall be delivered in standard size unopened bags of the vendor, showing weight, mixture, vendor's name and guaranteed analysis.

1.07. STORAGE

A. Seed shall be properly stored in dry conditions at the site of the work.

1. Any seed damaged or spoiled during storage shall be replaced by the Contractor.

1.08. ENVIRONMENTAL CONDITIONS

A. Topsoil shall not be delivered or placed in a frozen or muddy condition.

B. Seeding is to be done on dry or moderately dry soil.

1. Seeding is to be done when the wind velocity does not exceed 5 miles per hour.

1.10. SCHEDULE

A. The Contractor is advised to do all seeding during the periods of May 1st to June 15th, or August 15th to October 1st.

1. Seeding may be conducted under unseasonable conditions without additional compensation, and at the option and full responsibility of the Contractor.

1.11. GUARANTEE

A. Any new, reestablished, replaced or disturbed plant material that fails to respond properly within the one-year guarantee period shall be replaced as specified above at the Contractor's expense.

PART 2 PRODUCTS

2.01. MATERIAL

A. Topsoil

1. Topsoil shall be natural, fertile, friable agricultural soil capable of sustaining healthy vegetative growth.
2. Topsoil shall meet the following gradation requirements free of stones, roots, sticks and other foreign substances:

Grain Diameter	Sieve Size	Percent Passing by Weight
6.3 mm	6.3 mm	100
4.75 mm	No. 4	60-85
0.075 mm	No. 200	20-45
0.002 mm	--	7-27

a. Topsoil shall contain less than 52 percent sand.

3. The pH of topsoil shall be between 5.0 and 7.0.

4. Topsoil shall contain no less than 6.0 percent organic matter.

5. Topsoil may be from previously excavated, stockpiled and protected materials, provided the materials meet the requirements for topsoil.

B. Fertilizer

1. General Fertilizer

a. Fertilizer shall be a complete, partially organic, commercial 10-6-4 fertilizer.

b. All fertilizer shall contain a minimum of 10 percent nitrogen, 6 percent available phosphorous and 4 percent potash.

c. Other commercially available fertilizers, such as 20 10-10 and 12-6-6, may be utilized provided that spreading rates are adjusted to provide the aforementioned minimum requirements for nitrogen.

2. Plant Fertilizer - As recommended by local Soil Conservation District of the Department of Agriculture for the type(s) of soil(s) and plant(s).

C. Seed

1. All seed shall be fresh, re-cleaned and of the latest crop year.

2. Each component shall meet or exceed the minimum State and Federal requirements for purity and germination for that component.

3. The weed content of each component shall not exceed 0.1 percent.

4. The following seed mixture is suggested for lawns or cultivated (landscape) areas:

Percent by Weight	Variety	Purity	Germination
50	Kentucky Blue Grass	85%	80%
20	Red or Chewing Fescue	97%	80%
30	Red Top	92%	90%

a. Variations may be recommended by qualified personnel, but shall not be used without approval by the Engineer.

D. Mulch for Tree or Shrub Plantings - Mulch shall consist of dry, clean, hardwood chips.

E. Mulch for Seeded Areas - Mulch shall be oat, wheat or rye straw, or hay, free from noxious weeds and other materials which may interfere with the establishment of a healthy stand of grass.

F. Plantings - Trees, shrubs, vines, ground cover and other vegetation to be replaced or installed new as specified which meet the requirements of the American Association of Nurserymen.

1. Classifications of plants, dimensions, planting procedures, etc., shall conform to ANSI Standard Z 60.1, “Nursery Stock”.

G. Peat Moss - As recommended by the supplier of nursery stock.

H. Metal Edging

1. Edging shall be 3/16-inch thick by 4-inches high steel in 16- and 20-foot lengths.

a. Secure edging with 16-inch long tapered steel stakes at 30 inches on center.

b. All steel materials shall be painted with one coat of epoxy primer and two coats of epoxy finish.

I. Weed Barrier - Weed barriers shall consist of two plies of 6-mil thick black polyethylene film.

J. Stones

1. All stones used for landscape surfacings shall be between 2 and 4 inches in maximum dimension and average to about 3 inches.

a. Stones shall be well-rounded.

2. All stones used for mowing strips shall be a washed crushed stone, size 1/2-inch to 1-inch size.

K. Tree Wrapping - Wrapping for trees shall be 8 ounce first quality burlap.

PART 3 EXECUTION

3.01. EXAMINATION

A. Determine that surface area is ready for fine grading and/or to receive topsoil and seeding or plantings.

1. Remove trash, debris, large stones and other foreign materials from surface areas to be restored or rehabilitated.

2. Topsoil shall be free of frozen fragments, debris, large stones, and other foreign materials.

3.02. PREPARATION

A. Fine Grading - Areas requiring topsoil shall be fine graded to within 4 inches of finished grade to provide a minimum compacted thickness of 4 inches of topsoil at all locations.

1. All such areas, whether in cut or fill, shall be raked to a depth of 1 inch, be parallel to finished grade as shown or required and shall be free of all stones, larger than 1 inch, roots, rubbish and other deleterious material.

3.03. INSTALLATION

A. Areas to be Developed

1. When the project site is to be modified and developed to meet new conditions, the Contractor shall perform all required grading, topsoiling, fertilizing, seeding, planting, mulching and maintenance of areas, all in accordance with the Drawings and as specified herein.

2. Unless shown otherwise on the Drawings, the entire unpaved area within the grading limits and within the overall areas excavated and backfilled shall be so developed.

3. New landscaping work and artificial features, if any, are shown on the Drawings and specified elsewhere.

B. The Contractor shall reestablish all existing cultivated or landscape items, trees, shrubs, vines and ground covers as practicable.

1. Contractor shall provide additional or modify existing vegetation, as shown on the Drawings.

2. Existing trees, plants, shrubs, saplings, ground cover, vines, etc., which are disturbed or damaged by the Contractor's operations shall be replaced with new plant materials.

3.04. TOPSOILING

A. Topsoil shall be furnished and spread in the required areas to a depth of approximately 4 inches.

1. Stockpiled topsoil may be used if approved by the Engineer.

2. In the event this topsoil is not satisfactory, or is inadequate to cover the required areas, the Contractor shall furnish the required amount of satisfactory topsoil from approved sources off the site.

B. The soil shall be uniformly compacted with a light hand roller to a final depth of not less than 2 inches.

1. When finished, the surface shall conform to the finished grades shown or required and shall have a smooth pulverized surface at the time of seeding.

2. Any irregularities shall be corrected before the fertilizer and seed are placed.

3. Any subsequent settlement or displacement of the topsoil shall be restored to an acceptable condition at the Contractor's expense.

3.05. FERTILIZING

A. The fertilizer shall be uniformly spread by a mechanical spreader at the rate of 25 lbs. per 1,000 square feet.

1. The fertilizer shall be incorporated into the upper 2 inches of topsoil immediately after spreading.

2. Other commercial fertilizers, such as 20-10-10 or 12 6-6 may be used at rates adjusted to provide the same quantity of nitrogen per 1,000 square feet.

3.06. SEEDING

A. Seed shall be applied at a rate of not less than 5 lbs. per 1,000 square feet, using a mechanical spreader.

1. Upon completion of the seeding, the area shall be raked lightly and rolled with a light hand roller.

B. The process of spraying grass seeds, water, fertilizer and mulch known as hydro-seeding or hydro-mulching may be utilized provided that water hazards are minimized.

1. Presoaking, the spraying of the materials and watering after spraying shall be in strict accordance with the manufacturer's instructions.

2. All materials, protection, maintenance, etc., shall be in conformance with this specification.

3. The mulch may be a wood fiber material compatible with the spray equipment.

3.07. PLANTING

A. All new plant materials which are to replace existing plant materials shall be of the same genus and species as the original, and shall be placed in the same location as the item being replaced.

1. The size of the new plant materials shall, if practical, match that of the item being replaced, consistent with normally available sizes from nursery stock.

2. Depending on the size and type of material, and when ordered by the Engineer, guy wires, stakes, anchors and wrappings shall be furnished and installed in a proper manner to brace and protect the plant.

3. The Contractor shall, as soon as practicable, water and maintain all reestablished, replaced or disturbed plant materials until final acceptance of the contract.

B. Plant shall be set plumb and true.

1. Shape area around saucer to form drainage grades as shown on the Drawings.

C. Install wooden posts, guy wires and hose section for protection as shown on the Drawings.

1. Provide three guy wires per planted item.

D. For all trees of 2-inch caliber or larger, wrap with tree wrap.

1. Begin at base of tree and work upward to the first branches.

2. Tie the burlap wrap with cord (no synthetic cord nor wire) at 2-foot intervals and at the bottom and top.

E. Place weed barriers on prepared subgrade at depth shown on the Drawings.

1. Turn up weed barrier at all edges and corners.

F. Place washed stone over weed barriers to the specified depths.

1. Rake stone to produce a smooth, uniform surface.

G. Install metal edging such that the top edge projects 1/4 inch above surrounding soil and stone.

3.08. MULCHING AND PROTECTION

A. The Contractor shall protect and maintain seeded areas to assure a full even stand of grass.

1. Immediately after seeding and rolling, the Contractor shall apply oat, wheat or rye straw, or hay, free from noxious weeds, as a mulch, to a loose depth of about 1 inch.

2. The Contractor shall perform all watering and reseeding as necessary for a minimum of 30 days and until final acceptance of the Contract, to ensure the establishment of a uniform stand of specified grasses.

3.09. MAINTENANCE

A. Any portion of seeded areas failing to produce a full uniform stand of grass from any cause, shall be reseeded at full rate and re-fertilized at one-half rate and protected and maintained until such a full stand has been obtained.

B. Plantings to be maintained for one year following final acceptance of the contract.

3.10. SPECIAL CONDITIONS

A. Damaged Trees - Vegetation which has been damaged by site preparation activities and deemed non-functional by the Owner or engineer, shall be replaced by the Contractor with vegetation of the same caliper, genus and species at no additional compensation to the Contractor.

END OF SECTION

SECTION 03100

CONCRETE FORMWORK

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Formwork for cast-in-place concrete.

B. Form hardware, ties, etc.

C. Form removal; coordinate with rub finish requirements.

D. Camber requirements for beams and slabs.

1.02. REFERENCES

A. The publications listed below form a part of these specifications.

1. ACI 117 - Specification for Tolerances in Concrete Construction and Materials

2. ACI 301 - Specifications for Structural Concrete

3. ACI 347 - Recommended Practice for Concrete Formwork

4. ACI SP-4 - Formwork for Concrete

5. ASTM A653 - Steel Sheet, Zinc Coated

1.03. SUBMITTALS

A. Submit single-page catalog cuts showing the types of form ties with and without waterstops to be used.

B. Submit single-page catalog cuts showing all the types of formwork systems to be utilized for the project. (Do not include Contractor's design of formwork system.)

1.04. COORDINATION

A. Coordinate the installation of all cast-in (embedded) items that need to be included in the formwork.

B. Design, engineering, and construction of formwork shall be the responsibility of the Contractor and must achieve the desired end results.

1.05. DELIVERY, STORAGE, AND HANDLING

A. Deliver form and accessory materials to site in an undamaged condition. Defective or damaged materials shall not be used.

PART 2 PRODUCTS

2.01. MATERIALS

A. Form materials shall be new wood, new plywood, or steel. Do not use poor quality or used forms that will make a rubbed finish difficult to produce. Reference Section 03350, Concrete Finishes. Therefore, worn, used forms will not be allowed on exposed work.

B. Chamfer forming strips for exposed edges of concrete.

1. Exposed edges and outside corners of concrete shall be formed with 3/4-inch by 3/4-inch chamfer forming strips.

C. Reveal Strips

1. Reveal strips shall be provided as shown in the patterns and sizes indicated on the Contract Drawings for particular exposed concrete structures.

2. Reveal strips shall generally be 1 x 2 wood (or as indicated otherwise on the Contract Drawings), beveled approximately 1/4-inch each side to facilitate removal. The strips shall be sealed with a clear wood sealer prior to the application of form release agent.

D. Forms shall be coated with a release agent which will not stain concrete, absorb moisture, reduce the bonding characteristics of additional concrete coatings, or negatively affect the rubbed finish process. Use Euclid Chemical "Euco Super Slip," BASF Building Systems "Cast Off," or equal.

E. Form Ties

1. Form ties shall leave no metal closer than 1-inch to the surface of the finished concrete. The ends of the form ties shall create cone-shaped tie holes for sealing with plug mortar per Section 03350, Concrete Finishes.

2. Ties used for watertight and below-grade structures shall have a waterstop.

3. Snap ties without cone-shaped ends can only be used at unexposed portions of frost walls, retaining walls, and grade beams.

F. Joint forming materials for interruptions in concrete placement shall be per Section 03250, Concrete Joints and Accessories.

PART 3 EXECUTION

3.01. ERECTION INSTALLATION APPLICATION

A. Form surfaces shall be smooth and shall be removable in sections, such that no prying against the faces of the new concrete is necessary.

B. Earth cut forms shall not be used. All footings, slab edges, etc. shall be formed unless specifically shown otherwise on the Contract Drawings.

C. Soffit forms for beams and slabs shall be constructed to produce a built-in camber equal to 1/8 inch per 5 feet of span length unless indicated otherwise.

D. Erected forms shall be substantial and rigid, sufficiently tight to prevent leakage of laitance and properly braced and tied to maintain position and shape under the weight and pressure of the newly placed concrete. All joints between adjacent form panels shall be backed by a waler or stud. Seal formwork by gasketing and caulking to prevent leakage on the preceding placement below or adjacent.

E. Inspection and cleanout openings shall be provided as required.

F. Provide formed openings where required for items to be embedded in or passing through concrete work.

Locate and set in place embedded items which will be cast directly into concrete.

Coordinate work of other sections in forming and placing openings, slots, reglets, recesses, chases, sleeves, bolts, anchors, embedded frames, and other inserts.

G. Install chamfer forming strips on formwork at edges, outside corners, and at weir locations.

H. Apply form release agent in accordance with manufacturer's recommendations. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items. Do not apply form release agent where concrete surfaces will receive special finishes which are affected by agent.

I. Form Hardware

1. Form tie layout shall be in a neat pattern when finished concrete is exposed.

2. Form ties shall not be located within 6 inches from top of concrete placement.

3. No snap ties shall be broken off until the concrete is at least three days old and will not damage the concrete surface.

J. Tolerances for finish formed surfaces and variations in dimensions shall be in accordance with the following table:

TOLERANCES FOR FORMED SURFACES*

1. Variation from Plumb	
a. In the lines and surfaces of columns, piers, walls, etc.:	
• In any 10 feet of height	1/4 inch
• Maximum for the entire height if >40 feet	1 inch
b. For exposed corners of columns, wall corners, construction/control joint grooves, and other conspicuous vertical lines:	
• In any 20 feet of height	1/4 inch
• Maximum for the entire height if >20 feet	1/2 inch
2. Variation from Level or from Grades Specified	
a. In slab soffits, ceilings and beam soffits, measured before removal of supporting shores:	
• In any 10 feet of length	1/4 inch
• In any bay or in any 20 feet of length	3/8 inch
• Maximum for the entire length if >40 feet	3/4 inch

b. At top of walls, sills, and parapets; and along construction joint grooves and other conspicuous horizontal lines:	
• In any bay or in 20 feet of length	1/4 inch
• Maximum for the entire length if >40 feet	1/2 inch
3. Variation of the Linear Building Lines or Lines of Structure from Position in Plan and Related Position of Columns, Walls, and Partitions	
• In any bay	1/2 inch
• In any 20 feet of length	1/2 inch
• Maximum for the entire length	1 inch
4. Variation in the Sizes and Location of Sleeves, Floor Openings, and Wall Openings	±1/4 inch
5. Variation in Cross-Sectional Dimensions of Columns and Beams and in the Thickness of Slabs and Walls	-1/4 inch +1/2 inch
6. Footings and Thickened Edges of Slabs	
a. Variations in dimensions in plan:	-1/2 inch +2 inches
b. Misplacement or eccentricity:	
• 2 percent of the footing width in the direction of misplacement but not more than 2 inches	
c. Thickness:	
• Decrease in specified thickness	5 percent
• Increase in specified thickness:	No limit but increased thickness must be maintained for minimum 5-foot length

*Tolerances apply to concrete dimensions only, not to positioning reinforcing steel or embedded items.

3.02. FIELD QUALITY CONTROL

A. Prior to placing concrete, inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design. Verify that all supports, fastenings, wedges, ties, and items are secure.

B. Clean and vacuum formed cavities of debris prior to placing concrete.

Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior of formwork through cleanout ports.

C. During cold weather, remove ice and snow from within forms. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. De-icing salts will not be permitted. (Reference Section 03370, Concrete Curing and Protection.)

D. Damaged or previously used form liners shall not be used and shall be replaced at Contractor's expense.

3.03. FORM REMOVAL

A. The Contractor shall assume full responsibility for the strength of all components from which forms are removed.

B. Forms and supports shall remain undisturbed until the concrete has attained sufficient strength to support its own weight in addition to any collateral loads (temporary or permanent) that may be placed upon it during subsequent work. In no event shall any forms be loosened or removed prior to 24 hours' wet cure time.

C. Non-structural vertical forms such as beam side forms, column forms, and wall forms may be removed at any time after 24 hours, provided that stripping does not damage surfaces and such action does not endanger any part of the structure. Coordinate timing of form removal with rub finish requirements specified in Section 03350, Concrete Finishes.

D. No structural forms and shoring supporting underside of slabs or beams shall be removed prior to concrete attaining at least 80 percent of the required design strength and no less than 14 days after placing concrete. Field-cured cylinders (paid by the Contractor) can be taken for consideration to remove the structural forms sooner than 14 days.

During cold weather conditions, do not remove structural forms sooner than 21 days after placing concrete. Reference Section 03370, Concrete Curing and Protection, for cold weather requirements.

E. Immediately reshore all concrete required to support formwork for subsequent concrete placement. Any slab to be cast shall be shored downward.

END OF SECTION

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Reinforcing bars.

B. Welded wire reinforcement.

C. Bar supports and bolsters.

1.02. REFERENCES

The publications listed below form a part of these specifications.

A. American Concrete Institute

1. ACI 301 - Specifications for Structural Concrete

2. ACI 315 - Details and Detailing of Concrete Reinforcement

3. ACI 315R - Manual of Engineering and Placing Drawings for Reinforced Concrete Structures

4. ACI 318 - Building Code Requirements for Structural Concrete

5. ACI 350 - Code Requirements for Environmental Engineering Concrete Structures

6. ACI 530 - Building Code Requirements for Masonry Structures

B. American Society for Testing and Materials

1. ASTM A185 - Steel Welded Wire Reinforcement, Plain, for Concrete

2. ASTM A497 - Steel Welded Wire Reinforcement, Deformed, for Concrete

3. ASTM A615 - Deformed and Carbon-Steel Bars for Concrete Reinforcement

4. ASTM A767 - Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement

5. ASTM A780 - Standard Practice for Repair of Damaged Hot-Dip Galvanized Coatings

6. ASTM A970 - Specification for Welded or Forged Headed Bars for Concrete Reinforcement

7. ASTM C1116 - Specification for Fiber-Reinforced Concrete and Shotcrete

8. ASTM E329 - Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

C. Concrete Reinforcing Steel Institute (CRSI) - Placing Reinforcing Bars.

D. American Welding Society (AWS) - AWS D12.1, Reinforcing Steel Welding Code for Reinforcing Steel.

1.03. SUBMITTALS

A. Reinforcement Shop Drawing - Submit shop drawings in accordance with ACI 301, ACI 315, ACI 315R, and as modified below.

1. Shop drawings shall be clear enough so that every reinforcing bar in the structure can be located and shall be complete with all dimensions of the structure without the need to refer to the Contract Drawings.

2. A reinforcing bar layout plan shall be provided for each slab or walkway level, and an elevation view reinforcing bar layout shall be provided for each wall.

3. Shop drawings shall clearly indicate all construction joints, expansion joints, and control joints. Contractor shall coordinate with the reinforcement detailer so that all reinforcement interruptions and/or all splices can be shown and accounted for in the detailing.

4. Reinforcement shall be shown as bent where needed to clear waterstops and/or maintain uniform cover. Bars with bends shall be indicated schematically on the plan and elevation views.

5. All openings and pipe penetrations in walls and slabs shall be indicated on the reinforcement shop drawings (coordinated by Contractor). Formed openings larger than 1.25 times the rebar spacing in any direction shall be detailed with additional reinforcement around the opening in accordance with the Standard Detail on the Contract Drawings.

6. Photocopies of Contract Drawings, in whole or in part, will not be acceptable.

7. All re-submittals of shop drawings shall have all revisions/corrections clearly highlighted to the Engineer (e.g. labeled, clouded, etc.)

8. Final corrected copies of shop drawings (for file and to be used in the field) shall be submitted a minimum of 14 days prior to start of installation.

9. No reinforcing bar fabrication shall commence until shop drawings are approved.

10. All reinforcing bars shall be shop fabricated. No reinforcing bars shall be field bent.

B. Mill test reports showing physical and chemical analysis shall be provided for Engineer's records.

C. Submit catalog cut for threaded rebar splicing system.

D. Submit catalog cut for mechanical rebar splicing system.

E. Submit catalog cuts, clearly marked to indicate reinforcing bar supports and bolsters to be used for walls and slabs.

1.04. COORDINATION

A. All construction joints, expansion joints, and control joints must be coordinated by the Contractor so that all reinforcement interruptions and/or splices can be shown.

B. Contractor shall locate all wall/slab openings and pipe penetrations on the shop drawings prior to Engineer's review and approval.

C. Required adjustments to reinforcing bars to accommodate cast-in (embedded) items shall be shown and detailed on the shop drawings.

D. Contractor shall coordinate the supply of all bar supports and bolsters.

1.05. QUALITY ASSURANCE

A. Reinforcement work shall conform to the applicable requirements of ACI 301, ACI 315, ACI 318, and CRSI referenced publications.

B. All reinforcing bars shall have the manufacturer's mill marking rolled into the bar which shall indicate the producer, size, type, and grade.

C. All reinforcing bars shall be neatly bundled and tagged for placement when delivered to the job site. Bundles shall be properly identified for coordination with mill test reports.

1.06. DELIVERY, STORAGE, AND HANDLING

A. Deliver reinforcing bars and accessory materials to the site in an undamaged condition.

B. Reinforcement shall not be stored in direct contact with earth and shall be kept free of mud.

C. Bundles of bars may be loaded in or on structures, providing the Contractor avoids premature loading or overloading of the structure. Surface protection from rust stains or damage shall be provided by the Contractor.

D. Equipment for handling galvanized reinforcing bars shall have protected contact areas. Bundles of coated bars shall be lifted at multiple pick-up points to minimize bar-to-bar abrasion from sags in the bundles. Coated bars shall be stored on protective cribbing.

PART 2 PRODUCTS

2.01. MATERIALS

A. Deformed Reinforcing Bars - ASTM A615, Grade 60.

B. Welded Wire Reinforcement (WWR) - ASTM A185 for plain wire and ASTM A497 for deformed wire, supplied in flat sheets only.

C. Bar Supports and Bolsters

1. Bar supports and bolsters shall be a non-bleeding and non-staining material where concrete surfaces remain exposed. Plastic, plastic tipped, or stainless steel bar supports shall be used for uncoated reinforcing bars. Galvanized reinforcing bars shall utilize bar supports and bolsters that are galvanized, coated with epoxy or another polymer, or made of plastic.

2. Bar supports bearing on grade, insulation, or soft material shall be continuous runner type supplied with continuous welded on plates. Individual high chair supports will not be considered adequate.

   Alternatively, minimum 4,000 psi precast concrete blocks specifically cast for proper support of reinforcing bars can be utilized. The use of pavers, brick, or concrete masonry units (CMU) to support reinforcement shall not be permitted.

2.02. SOURCE QUALITY CONTROL

A. Shop Inspection - The Engineer reserves the right to inspect the manufacturer's facilities while fabrication of reinforcing bars for this project is being performed.

PART 3 EXECUTION

3.01. ERECTION INSTALLATION APPLICATION

A. Placement of reinforcement shall be in accordance with ACI and CRSI referenced publications.

B. Reinforcing bars shall be spaced as shown on the approved shop drawings. Deviations with bars spaced up to 1.25 times the required spacing, necessary because of interference with inserts, conduits, piping, small openings for ducts, etc., are allowable as long as four consecutive bars average out to the required spacing.

C. Where larger openings are encountered and reinforcing bars must be cut, equivalent splice bars (rounded bars) must be placed at each side of the opening plus #5 diagonal bars enveloping the opening at each corner (reference Standard Detail on Contract Drawings).

D. Reinforcing bars shall be accurately located in forms and held in place before and during concreting by using supports of adequate strength and black annealed tie wire (#16 gage or heavier), to prevent bar displacement.

E. Tie wires shall be bent into the wall or slab so as to not intrude into the reinforcement concrete cover space.

F. Install bar supports and bolsters as specified in Part 2. Pavers, brick, or CMU supports shall not be permitted. Additional bar supports shall be installed to eliminate deflection of reinforcement.

G. The minimum distance between non-lap spliced, parallel bars shall be two times the bar diameter, but in no case shall be less than 1 1/2 inches.

3.02. COVER

A. Clear concrete cover shall conform to ACI 318 and ACI 350 unless noted otherwise.

B. For structures exposed to earth, water, or weather (such as wet wells, channels, tanks, foundation walls, etc.), the clear cover shall be 2 inches (for severe exposure).

C. The reinforcing bars of footings, base slabs, and other members in which concrete is deposited against the ground shall have 3 inches of concrete cover between it and the ground contact surface.

D. Ends of reinforcing bars shall extend up to 2 inches from the outside face of the members into which they frame or terminate.

3.03. WELDED WIRE REINFORCEMENT

A. Welded wire reinforcement shall be adequately supported, anchored, and tied integrally with the framework system to assure its final location in the slab. Lap the ends/edges of each sheet in accordance with CRSI procedures, but shall be lapped a minimum of 6 inches.

B. The practice of "walking in" and placing the mats of reinforcement in freshly placed concrete will not be permitted.

3.04. DEVELOPMENT AND SPLICE LENGTHS

A. All splicing of reinforcing bars shall be lap-spliced with bars placed in contact with each other and wired securely.

B. Minimum lap splice or development length for reinforcing bars shall be as indicated on Contract Drawing. Special splices shown on the Contract Drawings, however, shall be lapped for the lengths indicated.

C. Attention is directed to the fact that the top bars in beams or grade beams are required to extend one third of the span into the adjacent span (see typical bar placing diagram for beams). These top bars are not intended as splice bars, but are full value top reinforcement. The preferred placement is to have the required minimum space between all top bars. Bundling in pairs will be allowed if all the rules for bundled bars (per ACI 318) are met.

D. Splices shall not be placed at points of maximum stress. However, in instances where they are unavoidable, the splice location in every second parallel bar shall be offset by alternating at least one and a half times the splice length.

E. Base mat bottom bar splices shall not coincide with wall dowel locations. Offset adjacent bottom bar splices to avoid reinforcing bar congestion.

F. Welding of reinforcing bars shall not be allowed unless specifically approved by the Engineer.

G. Observe the rules for staggering splices in accordance with ACI and CRSI.

3.05. FIELD QUALITY CONTROL

A. The Contractor shall advise the Engineer of his intentions to place concrete at least 48 hours prior to concrete placement to allow for Special Inspections (as required) and observation of installed reinforcement and embedded accessories, including waterstops, keyways, and other items.

B. Any repairs, corrections, cleaning, removal of debris, etc., shall be accomplished prior to start of concrete being placed.

C. Reinforcement installed within wall forms and in any deep formwork shall be checked by the Contractor and verified by the Engineer before closing the form, as well as immediately prior to placing concrete.

D. Prior to concrete deposition, reinforcement shall be free from mortar (concrete splash from previous placement), mud, loose mill and rust scale, grease, oil or any other coatings, including ice, that would reduce bond with the concrete.

E. Where there is a delay in depositing concrete, reinforcement shall be rechecked and cleaned when necessary. Cleaning shall be done by whatever mechanical means is necessary to return it to an acceptable condition.

END OF SECTION

SECTION 03250

CONCRETE JOINTS AND ACCESSORIES

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Concrete joints.

B. Waterstop material.

C. Sealant material for submerged joints in concrete.

D. Miscellaneous joint accessories.

E. Bonding agent.

1.02. SUBMITTALS

A. Submit one-page catalog cuts for joint filler material and joint sealant, clearly indicating which item(s) are to be used.

B. Submit one-page catalog cuts for waterstops and waterstop accessories, clearly indicating which item(s) are to be used.

C. Submit one-page catalog cut for bonding agent.

1.03. DELIVERY, STORAGE, AND HANDLING

A. Store materials off the ground to provide protection from dampness and soil.

PART 2 PRODUCTS

2.01. TYPES OF JOINTS

A. Construction Joint – The joint between two adjacent concrete placements, created by casting fresh concrete in contact with a previously cast (hardened) concrete. All typical reinforcement passes through the joint. A minimum of three days shall elapse between the casting of adjacent concrete placements for construction joints in liquid containment structures or as indicated on the Contract Drawings.

B. Isolation Joint – The joint between two adjacent concrete placements, created by casting fresh concrete adjacent to a previously cast (hardened) concrete placement, but separated by a joint filler material, to allow for expansion and contraction of concrete.

C. Expansion Joint – A joint constructed similar to an isolation joint to allow for expansion and contraction of concrete, but a slip dowel (sleeved) passes through the joint to limit differential displacement.

2.02. MATERIALS

A. Joint Forming Materials

1. Construction and control joints for interruptions in concrete placement in tank base slabs, mat foundations, beam and slab systems, and walls shall be made from lumber with custom cut holes or slots to pass reinforcing bars through and with standard keyway (and waterstop if applicable). These “bulkheads” are to be securely fastened to the deck, wall, and/or beam forms. They shall be the same depth as the concrete section and produce dense, clean, straight edges (top, bottom, and sides) when stripped.

2. Construction joints for interruptions in non-structural slab-on-grade concrete placements shall be fabricated from either custom built lumber “bulkheads” or galvanized steel shaped to form a tongue-and-groove mechanical key joint with preformed knock out holes. The steel shaped unit shall be the same depth as the concrete, but shall terminate a minimum 1 inch below top surface.

3. Control joints for slab-on-grade construction shall be saw cut. Seal cut joints as specified in Section 07900, Joint Sealants.

B. Joint Filler Materials

1. Expansion joint filler material shall be performed, closed cell, high grade polyethylene or non-extruding PVC, such as “Expansion-Joint Filler” by BASF Chemical Company, “Plastic Expansion Board” by Westec Barrier Technologies, “Deck-O-Foam” by W.R. Meadows, Inc., or equal.

2. Isolation joint filler material shall be closed cell rigid foam, cork, or non-impregnated fiberboard.

3. The joint filler shall be compatible as a backup material, with regard to the sealant not bonding to or being stained by the backup. If the joint filler is a material that will bond to the sealant, non-bonding polyethylene strip shall be used to cover the back-up material.

C. Joint Sealants

1. Sealant for joints in concrete structures that either contain or hold out liquids (including groundwater) such as tankage, basements, flow channels, galleries, etc. shall be a two-component polyurethane material designed for submerged conditions.

2. Use Sika Corporation “Sikaflex-2c,” Euclid Chemical Company “Eucolastic II,” or equal.

3. Sealant for non-liquid conditions are as specified in Section 07900, Joint Sealants.

D. Waterstops for Use in Liquid Containment Structures (Tankage) and/or at Below-Grade Structures Intended to Hold Out Liquids

1. Waterstop material shall be PVC 6-inch by 3/8-inch ribbed center bulb waterstop “No. CR 6380 Wirestop” by Paul Murphy Plastics Company; “No. 705” by Greenstreak; or equal. Split units may be used instead of splitting the formwork.

2. As shown on the Contract Drawings, where new concrete is cast against hardened concrete:

   a. Use a special shape, bolt-on "retrofit," PVC waterstop set in epoxy adhesive against existing concrete and fastened down with stainless steel fasteners through stainless steel batten strips.

      1) In walls or slabs 15 inches or greater, use a bolt-on T-shaped waterstop with a nominal 3-inch stem. Use "Item #609" by Greenstreak, "Item RET638" by Vinylex, or equal.

      2) In walls or slabs less than 15 inches, use a bolt-on L-shaped waterstop with a nominal 3-inch stem. Use "Item #581" by Greenstreak, "Item KK611" by Vinylex, or equal.

3. To provide continuity of waterstops in all applications where complete heat welding is not achievable, use a water-swelling sealant such as "Akwaswell" by CETCO Building Materials Group, "Leakmaster" by Greenstreak, or equal.

E. Bonding Agent – Use a corrosion inhibiting, non-vapor barrier, extended open time bonding compound. Use Sika Corporation "Armatec 110 EpoCem," BASF Chemical Company "Emaco P24," Euclid Chemical Company "Duralprep A.C.," or equal.

PART 3 EXECUTION

3.01. INSTALLATION OF CONSTRUCTION JOINTS

A. Construction Joints in (Non-Structural) Slabs-on-Grade

1. Construction joints are placed in the slab where the concreting operations are concluded for the day in conformity with a predetermined joint layout (i.e., at location of control or isolation joints). If concreting is interrupted long enough at any time for the placed concrete to harden, a construction joint shall be used.

2. If possible, construction joints should not be located nearer than 5 feet from any other joint to which they are parallel.

3.02. INSTALLATION OF CONTROL JOINTS

A. Control Joints in Slabs-on-Grade

1. Control joints in slabs-on-grade with a single layer of reinforcement shall be provided as shown on the Contract Drawings.

2. Joints shall be saw cut. Cutting shall be done as early as possible and within 24 hours after the concrete has set. (Wait just long enough that the blade does not ravel the edges of the fresh concrete.) The saw shall be guided to ensure straight cuts. The saw cut shall be a minimum of 1/8-inch wide and a set depth of 1/2 inches.

3. After curing, the joints shall be filled with approved backer rod and sealant as specified in Section 07900, Joint Sealants.

3.03. INSTALLATION OF EXPANSION AND ISOLATION JOINTS

A. Isolation Joints for Slabs-on-Grade

1. Slabs-on-grade shall be separated structurally from other building elements to accommodate differential movement. Isolation joints shall be used where shown on the Contract Drawings.

2. Joint material shall be removed to the depth required for installation of sealant.

3.04. INSTALLATION OF JOINT ACCESSORIES

A. Waterstops

1. Waterstops shall be continuous through all slab and wall joints without interruptions to assure watertightness. Hold waterstop down 3 inches from the exposed top of walls not covered by a slab.

2. Waterstops shall be installed in accordance with the manufacturer's directions.

3. For PVC (and Thermoplastic) Waterstop Installation.

a. Splices shall be made with heat welding or with splicing accessories, either method to follow manufacturer's recommendations. Where complete heat welding is not achievable, provide continuity by using a water-swelling sealant. The water-swelling sealant is to only supplement heat welding, not replace it.

b. The waterstop shall be securely wired in place 12 inches on center to preserve its position prior to and during the placement of concrete.

c. Thoroughly vibrate fresh concrete around waterstop during concrete placement.

4. For Bolt-On "Retrofit" Waterstop Installation.

a. The existing concrete surface shall be prepared by abrasive blasting or grinding and washing prior to installation.

b. Set bolt-on retrofit waterstop in a bed of epoxy adhesive and fasten down to concrete surface with stainless steel batten bars and concrete fasteners, as required per manufacturer's installation requirements.

c. Follow the same splicing procedures as for PVC waterstop installation.

B. Sealant

1. Sealant shall be installed in accordance with the manufacturer's instructions. Primer shall be applied as recommended by the manufacturer.

2. Sealant depth (at midpoint) shall be appropriate for the joint width.

a. The sealant depth shall be controlled by the use of joint fillers or back up materials. The backup material shall be non-impregnated and compressible; such as backer rod.

1) Backer rod shall be about 1/8 inch larger in diameter than the width of the joint to allow for compression.

2) Where the depth of the joint does not permit the use of backer rod, a bond breaker (polyethylene strip) must be used to prevent bonding to the back of the joint.

b. Joint fillers shall be held back for sealants. Where joint filler is flush with the adjacent concrete, enough filler material shall be removed so the joint can be sealed to the specified depth.

Joint Width and Sealant Depth	
Joint Width (Inches)	**Sealant Depth at Midpoint (Inches)**
1/4 to 1/2	1/4
1/2 to 1	3/8 to 1/2
1 to 2	1/2

3. Sealant shall be applied to both sides of all joints where accessible, but shall not be installed prior to successful liquid tightness (leak) testing where applicable.

C. Bonding Agent - Prior to placing fresh concrete against existing hardened concrete, apply a bonding agent.

1. Apply bonding agent for toppings, equipment/ housekeeping pads, and patches.

2. Do not apply bonding agent on control joints.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01. SCOPE OF WORK

A. It is the intent of these specifications to produce high quality, dense, durable, watertight (if applicable) concrete. The Contractor will be responsible for the final in-place concrete quality. Care shall be taken in development of mix designs and during mixing, placing, curing, and finishing to achieve the desired end result. The Contractor will be responsible to repair leaks (if applicable), cracks, unsound concrete, and poor finishes to the satisfaction of the Owner, at no additional cost.

B. Section includes:

1. Concrete mix design requirements.

2. Placement and care of concrete.

3. Restrictions regarding embedments in concrete.

4. Concrete testing.

5. Concrete repair (of newly cast concrete).

1.02. REFERENCES

The publications listed below form a part of this specification.

A. American Concrete Institute (ACI)

1. ACI 201.1 - Guide for Conducting a Visual Inspection of Concrete in Service

2. ACI 211.1 - Selecting Proportions for Normal, Heavyweight, and Mass Concrete

3. ACI 301 - Specifications for Structural Concrete

4. ACI 302.1 - Guide for Concrete Floor and Slab Construction

5. ACI 304 - Measuring, Mixing, Transporting and Placing Concrete

6. ACI 305R - Hot Weather Concreting

7. ACI 306R - Cold Weather Concreting

8. ACI 309 - Guide for Consolidation of Concrete

9. ACI 318 - Building Code Requirements for Structural Concrete

10. ACI 350R - Code Requirements for Environmental Engineering Concrete Structures

B. American Society for Testing and Materials (ASTM)

1. ASTM C31 - Making and Curing Concrete Test Specimens in the Field
2. ASTM C33 - Concrete Aggregates
3. ASTM C39 - Compressive Strength of Cylindrical Concrete Specimens
4. ASTM C42 - Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
5. ASTM C94 - Ready-Mixed Concrete
6. ASTM C138 - Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
7. ASTM C143 - Test Method for Slump of Hydraulic-Cement Concrete
8. ASTM C150 - Portland Cement
9. ASTM C172 - Sampling Freshly Mixed Concrete
10. ASTM C231 - Air Content of Freshly Mixed Concrete by the Pressure Method
11. ASTM C260 - Air-Entraining Admixtures for Concrete
12. ASTM C295 - Petrographic Examination of Aggregates
13. ASTM C311 - Sampling and Testing Fly Ash or Natural Pozzolans for Use in Concrete
14. ASTM C457 - Determination of Air Voids in Concrete
15. ASTM C494 - Chemical Admixtures for Concrete
16. ASTM C595 - Specification for Blended Hydraulic Cements
17. ASTM C618 - Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
18. ASTM C948 - Density, Water Absorption, and Apparent Porosity of Glass-Fiber Reinforced Concrete
19. ASTM C989 - Ground Granulated Blast-Furnace Slag for Use in Concrete
20. ASTM C1116 - Fiber-Reinforced Concrete and Shotcrete
21. ASTM C1218 - Test Method for Water-Soluble Chloride in Mortar and Concrete
22. ASTM C1260 - Test for Alkali Reactivity of Aggregates

1.03. SUBMITTALS

A. Qualifications statement regarding batch plant certification.

B. Prior to submittal of concrete mix designs, submit data on all ingredients to be used in the mix designs for pre-approval. All data shall be dated within the last 12 months.

1. Certified mill tests of cementitious materials (cement, fly ash, and slag).

2. Certified tests of fine and coarse aggregates meeting requirements in Part 2 of this specification.

3. Verification of fine and coarse aggregates' potential for alkali-aggregate reactivity provided by one or more of the following:

   a. Certified testing of aggregates for alkali-aggregate reactivity potential.

   b. Identification by State DOT for "ASR potential."

   c. Certified statement from source of aggregates pertaining to history of alkali-aggregate reactivity.

4. Catalog cuts of concrete admixtures,

C. Concrete Mix Designs - Concrete mixes used on this project shall be either established mixes verified by "Field Test Data" or new custom laboratory designed "Trial Mixtures." Requirements for either option are as follows.

All test data shall be dated within the last 12 months. Partial submittal will not be reviewed.

1. List amount and sources of mix ingredients:

   a. Cement.

   b. Pozzolans (fly ash and slag).

   c. Fine aggregate.

   d. Coarse aggregate.

   e. Water.

   f. Admixtures.

   g. Fibers (if required).

2. Strength Test Reports - The average strengths shall be higher than the required average compressive strengths (f'cr) as per ACI 301, paragraph 4.2.3.3. Concrete supplier shall perform calculations validating proposed concrete strengths.

3. Typed letter signed by an official from concrete supplier stating that all materials for proposed mix are identical (from the same source and of the same amounts) as materials used for concrete mix in the submitted strength test reports.

4. Certified test for amount of water-soluble chloride ion (CL-) in concrete.

D. Submit catalog cut for retarding admixture.

E. Submit catalog cut for surface-applied hot weather evaporation reducer.

F. Submit a filled-in sample batch plant ticket prior to the first concrete placement. Reference batch ticket requirements in Part 3 of this specification.

G. Submit special requests for embedment of conduit, etc. Reference restrictions in Part 3 of this specification.

H. If concrete repairs are needed for newly cast concrete as indicated in Part 3 of this specification, the Contractor shall submit proposed repair products and procedures specified in Section 03732, Concrete Repair.

1.04. COORDINATION

A. Coordinate all concrete placements with work (general, site/civil, architectural, structural, electrical, HVAC, instrumentation, mechanical, plumbing, etc.) indicated in all specifications and on all Contract Drawings.

B. Coordinate concrete placement with rock blasting restrictions.

C. Coordinate installation of all cast-in (embedded) items (i.e., grating frames, hatches, anchor rods, etc.) prior to start of concrete placement. Post-installation of cast-in items into new hardened concrete is not allowed.

D. Coordinate all concrete placements with testing and inspection requirements specified herein.

E. Obtain approval on Contractor's proposed curing and protection plan prior to placement of any concrete. Reference Section 03370, Concrete Curing and Protection.

1.05. QUALIFICATIONS

A. The concrete batch plant providing concrete to this project shall be certified by the State DOT.

PART 2 PRODUCTS

2.01. CONCRETE

A. Concrete Classes and Their Use

1. Mix A - All general uses not otherwise specified or provided for below.
2. Mix B - Liquid Containment Structures - All structural reinforced concrete in contact with process water.

3. Mix C - Concrete fill/topping (average thickness greater than 3 inches), pipe supports and encasements, and ductbanks.

4. Mix D - Concrete thrust blocks (below grade), and fill concrete below structures.

5. Mix E - Exterior slabs, platforms, walkways, sidewalks, road curbs, and truck unloading containment pads.

Mix	28-Day Compressive Strength (psi)	Coarse Aggregate Size per ASTM C33	Minimum Total Cementitious Content (lbs/CY)	Maximum Water/Cement Ratio (w/c)[1]	Air Content %[2]	Maximum Water-Soluble Chloride Ion (CL^-)
A	4,500	#57	575	0.44	6.0	0.30
B	4,500	#57	575[3]	0.42	6.0	0.10
C	4,000	#7	550	0.45	7.0	0.15
D	3,000	#467	425	0.50	6.0	0.30
E	5,000	#57	600	0.40	6.0	0.15

(1) These maximum water/cement ratios shall be considered for selection of supplier's mix designs. The water/cement ratio specified in the approved mix designs shall be the maximum used in production.
(2) Tolerance for air content is +1-1/2 percent.
(3) Fly ash content shall be 15 to 25 percent of total cementitious content. As an alternate to fly ash, use slag at 30 to 50 percent of total cementitious content. Maximum total cementitious content shall not exceed 660 lbs/CY..

B. Air Entrainment Requirements

1. All concrete exposed to weather or liquid shall be air-entrained as specified in the above chart.

2. For interior concrete, where finishes require a lower air content than specification requires, the air content shall be adjusted accordingly with the approval of the Engineer.

C. Concrete Slump

1. Without plasticizers, concrete slump for flatwork shall not exceed 3 inches. Wall concrete, columns, and deep beams (without plasticizers) shall be placed with a maximum slump of 4 inches.

2. Concrete with superplasticizer shall be designed for a target slump of 6 inches. Mixed concrete with a slump greater than 8 inches shall not be placed on this project.

2.02. MATERIALS

A. Cement

1. Cement shall be Portland cement Type I or Type II and shall meet the requirements of ASTM C150.

   If aggregates are susceptible to alkali-silica reactivity (ASR), cement shall be low alkali containing less than 0.60 percent of equivalent alkalis ($Na_2O + 0.658K_2O$) per ASTM C150, Table 2 unless other approved measures are included to mitigate ASR. Low alkali cement shall be tested frequently during construction, as outlined in Part 3, to monitor alkali levels.

2. If Type II cement is available, use for below-grade construction and for liquid containment structures or when air temperatures at the time of placement are expected to exceed 80 degrees F.

3. High early-strength cement (Type III with a maximum tri-calcium aluminate (C3A) content of 8 percent) shall only be used with advance written approval by the Engineer. Note that Type III cement would not be allowed for Mix B concrete.

B. Pozzolans

1. Mix B concrete and all concrete mixes utilizing aggregates with ASR potential shall contain pozzolans. (Reference the mix design chart above.)

2. Fly ash shall meet the requirements of ASTM C618 Class F except as modified below:

   a. Loss of Ignition, Maximum - 5.0 percent.

   b. Maximum Retained on #325 Sieve - 30 percent.

3. Blastfurnace slag material shall meet the requirements of ASTM C989. A blend of Portland cement and blastfurnace slag shall meet the requirements of ASTM C595 and be specifically manufactured to produce higher concrete strengths and provide greater resistance to chloride penetration and sulfate attack.

C. Aggregates

1. Fine Aggregate (Sand)

   a. Natural or manufactured siliceous sand.

   b. Quantity of deleterious substances limited by Table 1 of ASTM C33.

   c. Graded within the specified limits of ASTM C33.

2. Coarse Aggregate

   a. Crushed stone or crushed gravel.

   b. Quantity of deleterious substances limited by Table 3 of ASTM C33 for Class 4S aggregates.

   c. Graded within the specified limits of ASTM C33.

3. Five cycle soundness tests for fine and coarse aggregates shall meet the requirements of ASTM C33.

PERCENT LOSS

	Magnesium Sulfate	Sodium Sulfate
Fine Aggregate[(1)]	15	10
Coarse Aggregate[(2)]	18	12

(1) If provided results of soundness tests exceed these limits, it would be acceptable to provide a certified letter attesting to the favorable performance of the fine aggregates as outlined in ASTM C33, Article 8.

(2) Soundness tests for coarse aggregates do not need to be provided if they are approved by State DOT for use with concrete. Submit verification of such.

4. Source of fine and coarse aggregates shall not have a history pertaining to alkali-aggregate reactivity. In the event that aggregate source with potential alkali-aggregate reactivity is unavoidable, at least two of the following measures shall be taken to minimize this reaction:

    a. Provide low alkali cement.

    b. Use fly ash (minimum 20 percent content) or slag.

    c. Use lithium-based additives (proven to be effective based on testing of concrete).

D. Mixing Water - Clear and potable.

2.03. ADMIXTURES, ETC.

A. General Requirements - Admixtures other than those specified may only be used after written approval by the Engineer.

1. Admixtures shall be as manufactured by Master Builders Solutions (BASF Chemical Company); Sika Corporation; Euclid Chemical; Grace Construction Products; or equal.

2. All admixtures proposed shall be selected in advance so that the appropriate trial mixes can be made.

3. After material sources have been established and approved, these sources shall not be changed for the duration of the project.

4. The Engineer may require that a field representative of the admixture manufacturer provide occasional service in the field or batch plant to assure proper use of the admixture.

B. Air entrainment admixture shall meet the requirements of ASTM C260.

C. All concrete mixes shall contain a "water-reducing admixture" that meets the requirements of ASTM C494 Type A or a "high range water-reducing admixture" (superplasticizer) that meets the requirements of ASTM C494 Types F or G. These admixtures shall not contain chlorides.

D. Retarding Admixture - If air temperatures are expected to exceed 85 degrees F during the placement and/or finishing of any flatwork, a retarding admixture shall be used that meets the requirements of ASTM C494 Type D.

E. Evaporation Reducer - For all concrete flatwork during hot and/or windy weather conditions, apply to freshly placed concrete prior to finishing. Use BASF Chemical Company "Confilm," L&M Construction Chemicals "E-Con," Conspec (by Dayton Superior) "Aquafilm," or equal.

F. Acceleration admixtures associated with cold weather concrete shall meet the requirements of ASTM C494 Type C and shall not contain calcium chloride. (Reference Section 03370, Concrete Curing and Protection, for cold weather protection procedures.) Note that acceleration admixtures are not allowed in Mix B for liquid containment structures. Approval from Engineer shall be obtained prior to use.

PART 3 EXECUTION

3.01. PREPARATION, MIXING, AND HANDLING OF CONCRETE

A. Batch Plant Requirements - Measurement of materials at the batch plant shall be in accordance with ASTM C94.

B. The batch plant used to supply concrete for this project shall meet the following requirements:

1. Weight Hoppers - The plant shall have separate weight bins for cement and aggregate.

2. Scales - Shall measure the actual weight within an accuracy of 0.1 percent of full scale or one graduation, whichever is less. Scales shall be sealed annually by the Official Sealer of Weights and Measures.

3. Heating and Cooling of Materials

a. In cold weather, the batch plant shall be equipped to heat aggregates and water to produce concrete delivery temperatures at the project site greater than the minimum temperatures indicated below. Aggregates shall not contain ice or have frozen lumps nor shall they be heated to a temperature over 120 degrees F.

1) When ambient air temperature at time of placement is above 30 degrees F, concrete temperature must be at or above 55 degrees F.

2) When ambient air temperature at time of placement is below 30 degrees F, concrete temperature must be at or above 60 degrees F.

3) When ambient air temperature at time of placement is below 0 degrees F, concrete temperature must be at or above 65 degrees F.

b. In warm weather, the batch plant shall be equipped to cool water with ice, and cool aggregates by shading and spraying with cool water, to obtain concrete delivery temperatures at the project site of no greater than 95 degrees F. The Contractor shall take into account drive time, slump loss, admixtures, flash set, etc. and reduce delivery temperatures as appropriate.

4. Moisture Content - The automated batch plant shall adjust aggregate weights dispensed based on their moisture content.

C. Mixing Methods

1. All concrete shall be ready mixed and meet the requirements of ASTM C94.

The truck mixer shall be equipped with a water tank for carrying mixing water. Water added to the mixer shall be measured to the nearest gallon by use of a water meter. For all trucks arriving on site without an operating water meter, water shall only be added manually into the back of the truck using a calibrated container. Water carried within the truck water tank shall not be used unmetered.

Water can be added to the mixer to attain initial slump, but only within the limits of the specified water/cement ratio. After addition of water, the concrete shall be mixed at least 30 revolutions in the mixing speed range.

Mixers shall meet the requirements of the "Truck Mixer and Agitator Standards" Truck Mixer Manufacturer's Bureau and shall bear their certification plate.

Trucks shall be equipped with a revolution counting device.

2. A written delivery slip or ticket, prepared and signed by the plant operator shall be made out at the proportioning plant for each truck load batch. The delivery slip shall be given to the Engineer as soon as the truck arrives at the job site, and each slip shall show the following information, which represents actual quantities of batched materials in each truck:

   a. Truck number.

   b. Date and time truck is batched.

   c. Ticket number.

   d. Mix designation of concrete.

   e. Cubic yards of concrete.

   f. Cement type and weight in pounds.

   g. Weight in pounds of each size and type of aggregate.

   h. Admixtures, weights in pounds and ounce.

   i. Moisture content of fine and coarse aggregates.

   j. Water added to the batch at the plant.

   k. Water added to the batch during transport from plant to job site.

   l. Water added to the batch at the job site.

   The driver and/or testing laboratory technician shall record the number of gallons of water added during transport and at the job site. If no additional water is added, this shall be clearly indicated on the batch tickets. In no case shall the water/cement ratio be exceeded.

   Any truck delivering concrete to the job site without a delivery slip will be rejected and shall immediately depart from the job site.

3. After completion of mixing, discharging may begin immediately, otherwise the mixer shall be revolved at the agitating speed.

   The total time interval from when the cement makes contact with the aggregates to the completion of discharge shall not exceed 90 minutes. The Engineer may reduce the total time limit in hot weather or under unusual conditions if unsatisfactory results are obtained.

4. Mixing at the Construction Site - If the time limits specified cannot be consistently achieved by mixing at the plant or in transit, concrete shall be mixed completely in the truck mixer following the addition of the mixing water at the point of deposition.

   Trucks shall be loaded first with coarse and fine aggregates and admixtures during which time the drum may be revolved or rocked. Cement shall be added last and the drum shall remain stationary after the cement is added until water is added at the project site.

   Mixing shall begin at the project site after the addition of water and shall continue for a minimum of 100 revolutions or until a uniform mix has been produced. Mixing time shall not exceed 15 minutes.

   The entire load shall be discharged within 30 minutes after mixing has been completed.

3.02. EMBEDMENTS IN CONCRETE

A. Embed no pipes other than electrical conduit in structural concrete.

B. Obtain approval from Engineer for any variation from the following requirements unless shown on the Drawings. Make request in writing accompanied by suitable sketch.

1. Do not cut or displace any reinforcement.

2. Do not place conduit between concrete surfaces and reinforcement.

3. Restrict O.D. of conduit to 1/4 of slab thickness. Keep within middle half of that thickness.

4. Any bundle of conduits shall not exceed a diameter equal to 1/4 of slab thickness.

5. Place unbundled, parallel conduits at least 6 inches apart.

6. Conduits that cross must be bent such that they cross between 45 and 90 degrees from each other.

7. Conduits that cross can touch each other, but no more than three conduits (not exceeding total height of 1/3 of slab thickness) can cross at any given location.

8. Conduits that run parallel with any reinforcement shall be kept a minimum of 2 inches clear from that reinforcement.

9. Do not embed conduit in beams.

10. Total conduit cross sectional area embedded in columns shall be less than 4 percent of the gross concrete area of columns.

3.03. CONCRETE PLACEMENT

A. The Contractor shall notify the Special Inspector (when required), Engineer, and testing lab a minimum of 48 hours in advance of placement to allow sufficient time for scheduling and observation of the work and for any corrective measures which are subsequently required.

B. Preparation

1. Concrete shall not be placed until all reinforcement is secured in position, nor until the forms have been completely installed and cleaned of debris; coated; form ties retightened; all sleeves, castings, pipe, conduits, anchors, forms for openings have been placed and anchored by the Contractor, nor until all water, snow, and ice have been removed from the space to be occupied by the concrete.

2. Finishing installation of reinforcing and finalization of formwork concurrent with starting of concrete placement is not acceptable.

C. All porous soil or concrete surfaces against which new concrete is to be placed shall be wetted down and dampened prior to placement. Spraying from the concrete truck hose immediately prior to placement will not be considered sufficient.

D. Concrete shall be placed in accordance with ACI 302, ACI 304, and ACI 318.

E. Concrete shall be conveyed as rapidly as practicable to the point of deposit by methods which prevent the separation or loss of the ingredients.

F. Any concrete being placed shall not be allowed to free fall more than 5 feet as measured from the point of discharge to the bottom of the formed surface. All distances greater than 5 feet shall utilize elephant trunks with hoppers.

G. When placing concrete, sufficient illumination shall be provided in the interior of the forms so that the concrete, at places of deposit, is visible.

H. Concrete shall be placed and vibrated in layers not to exceed 30 inches. Reference ACI 309.

I. Vibration shall be applied directly to the freshly-placed concrete by successive vertical penetrations of the vibrator. It shall be of sufficient duration to accomplish thorough compaction and complete embedment of reinforcement and fixtures.

"Pencil" vibrators shall be on hand and utilized where required.

Vibration shall be supplemented by forking or spading by hand in the corners of forms.

When vibrating structural slabs, the vibrator must not ride the form supporting the slab.

Since the duration of vibration required is dependent on the frequency, size of vibrator, and slump of concrete, the length of time must be determined in the field.

Vibrators shall not be used to move concrete laterally within the forms.

J. Place concrete continuously and at full depth of slabs (so as not to permit cold joints) between predetermined expansion, construction, or control joints.

3.04. PUMPING CONCRETE

A. Pumping Concrete - If the pump operator does not have direct visual contact with the location of concrete placement, two-way radio communications shall be provided.

3.05. EQUIPMENT AND HOUSEKEEPING PADS

A. The General Contractor shall provide minimum 4-inch high concrete pads for all mechanical, plumbing, HVAC, and electrical equipment. If greater thicknesses are shown on the Contract Drawings or required by the equipment being installed, provide thickness required.

B. Verify all concrete pad sizes, locations, and anchors with various Contractors. If sizes are not dimensioned on the Contract Drawings, provide concrete pads 6 inches wider than the equipment in each direction.

C. Prior to placing concrete pads, use a bonding agent.

3.06. CONCRETE FINISHING

A. All flatwork concrete shall be finished immediately after placement per Section 03350, Concrete Finishes.

B. All formed concrete shall be finished after form removal. Coordinate timing of form removal within the seven-day rubbed finish requirements per Section 03350, Concrete Finishes.

3.07. CONCRETE CURING AND PROTECTION

A. All concrete shall be cured (and protected from hot or cold weather conditions) for a minimum of seven days. Submittal of proposed procedures is required; follow requirements of Section 03370, Concrete Curing and Protection.

3.10. INCOMPLETE STRUCTURES

A. Structures which are incomplete may not be capable of withstanding backfill, hydrostatic, surcharge, storage and other permanent or temporary loading conditions imposed during construction. Control of such loading conditions shall be the sole responsibility of the Contractor.

3.11. TESTING FOR QUALITY ASSURANCE

A. The Contractor will hire and pay for the services of a testing laboratory to perform the testing for quality assurance. Field testing shall consist of w/c ratio verification, temperature, slump, air content, density, and tests for the compressive strength. These test results shall be used by the Contractor to assist his control of quality in order to meet specified values. Additional testing for materials verification (including fine and coarse aggregate moisture content and water absorption, etc.) shall be conducted as directed by Engineer.

B. Testing will be required for each placement in excess of 5 cubic yards.

C. Location of Field Tests - All sampling for field tests (cylinders, air content, slump, etc.) shall be performed at the delivery truck to allow proper correlation of the tests.

When concrete is being pumped, additional air content testing shall be performed at the pump discharge to monitor air content changes through the pump and to maintain specified air content at location of concrete placement.

D. The following field tests will be performed by the testing laboratory for every concrete placement:

1. Water/Cement Ratio (Calculated Method)

   a. The water/cement ratio shall be calculated and recorded for each truckload of concrete delivered to the job site. This calculation shall account for all moisture in the mix including wash water, water added during transport and at the job site, and free moisture in both fine and coarse aggregates.

   b. Concrete which exceeds the water/cement ratio specified in the approved mix design shall not be utilized.

2. Temperature - Shall be recorded by the testing laboratory for each batch of concrete delivered to the project.

3. Slump Test - Slump tests shall be made in the field by the testing laboratory on each batch of concrete produced, in accordance with ASTM C143.

4. Air Content Test (Fresh Concrete)

   a. Test for entrained air content in accordance with ASTM C231. Concrete which does not contain the proper amount of entrained air shall not be utilized under this contract.

   b. A minimum of two tests will be required for each day of operations. Also, at least one test shall be made for each 50 cubic yards and each class of concrete placed within a single day.

   c. If concrete is being pumped, a test shall be performed at both the truck and the end of the pump discharge. These two tests shall be used to monitor the drop in air content due to pumping and to better regulate the air content in forthcoming concrete batches.

   d. In the event that test results are outside the limits specified, additional tests shall be required to show that concrete meets the specification requirements or the concrete shall not be used on this project. These additional tests shall be paid for by the Contractor.

5. Unit Weight (Density) - The unit weight of the fresh concrete shall be measured in accordance with ASTM C138. The unit weight shall be recorded at the same interval as required for air content testing as stated above.

6. Compressive Strength Test

   a. Samples of concrete will be taken and tested by the testing laboratory for compressive strength in accordance with ACI 301; ASTM C31, C39, and C172; except as modified herein.
   At least one sampling will be taken for each 50 cubic yards of each class of concrete placed within a single day. No more than one sampling may be taken from a single batch to satisfy this requirement.

   One sampling shall consist of four 6-inch diameter test cylinders. One cylinder will be tested at 7 days, and 2 cylinders tested at 28 days, and 1 held for testing at 56 days as needed.

Each cylinder will be identified by a tag, furnished by the Contractor, which will be hooked or wired to the side of the container.

It is the Contractor's responsibility that cylinders be stored in a temperature-controlled curing box, provided by the Contractor on the construction site, for 24 hours after they have been molded and held at a temperature between 60 degrees F and 80 degrees F. Provide a high/low thermometer to verify temperature range.

After 24 hours, the testing technician will transport the samples to the laboratory for moist curing until tested.

b. When field temperatures during the 24 hours immediately preceding the time of concrete placement have exceeded 85 degrees F, or have been less than 40 degrees F, or when freezing, hot weather, or other extraordinary field curing conditions are anticipated, or when requested by the Engineer, four additional cylinders shall be molded at each sampling for field curing.

These additional cylinders shall be located by the Contractor to be cured at the structure as near to the point where the sampled concrete was placed as practicable. These cylinders shall receive the same protection and be subject to the same environmental conditions as that portion of structure for periods of 5, 21, and 49 days from the date of molding.

The additional field-cured cylinders shall thereafter be transported to the laboratory and stored at laboratory room temperature and conditions for additional days until tested. One specimen tested at 7 days, 2 at 28 days, and 1 held for testing at 56 days if needed.

Note: 7- and 28-day laboratory cured specimens continue to be required as control specimens. Field-cured specimens will also be considered for concrete acceptance.

c. After job site storage, concrete test cylinders shall be transported in rigid boxes specifically sized and constructed to prevent specimens from becoming damaged from tipping, falling, rolling, or bumping.

d. After a mean value of a ratio between 7-day and 28 day strengths has been established from 10 or more samplings the 7-day strengths shall subsequently be taken as a preliminary indication of the 28-day strengths.

Thereafter, should a 7-day test strength from any sampling (laboratory cured) be more than 10 percent lower than the 7 day strength which corresponds with the specified 28 day compressive strength, the Contractor shall:

1) Immediately provide an additional seven days of curing in the affected area from which the deficient test cylinders were taken.

2) Correct the mix for the next concrete placement.

e. From laboratory cured specimens, the strength level of concrete will be evaluated for acceptance based on criteria in ACI 301, Chapter 17. Concrete is considered satisfactory if all of the following conditions are satisfied:

1) The average of 28-day cylinder tests for any three consecutive sets shall meet or exceed the strength required for the mix specified.

2) No more than 10 percent of the compressive strength test results from individual specimens shall have strengths less than that specified.

3) No single set of compressive strength test results falls below the specified strength by more than 500 psi.

f. The Contractor can request additional field-cured cylinders to verify adequate concrete strengths for early formwork removal. The Contractor shall reimburse the Owner for the testing of these additional cylinders.

g. In the event that the above conditions are not met and there is reason to imply that the low compressive strength results reflect actual concrete strength in the structure, additional tests shall be performed as outlined in Article 3.13.

E. The following additional tests will be performed by the testing laboratory periodically as indicated, as directed by the Engineer:

1. Aggregate Water Absorption - Prior to the first concrete placement, the testing laboratory shall obtain fine and coarse aggregate samples to determine and report water absorption. Aggregates shall be retested to adjust absorption values every 90 days until 95 percent of project concrete has been placed.

2. Aggregate Moisture Content - At Engineer's discretion, the testing laboratory shall visit the batch plant and obtain samples of fine and coarse aggregates for the purpose of verifying actual moisture content as reported by the batch plant.

3. Cement alkalinity (when low-alkali cement is used to mitigate ASR) - Prior to the first concrete placement, the testing laboratory shall obtain a cement sample to test for alkaline content. Testing laboratory shall report acceptability and conformance to requirements of ASTM C150 for ASR mitigation. Unless most current cement mill test reports are provided every 40 days, testing laboratory shall conduct additional sampling every 90 days until 95 percent of project concrete has been placed.

4. Water/Cement Ratio (Microwave Drying Method)

a. At the discretion of the Engineer, water/cement ratio of fresh concrete may be verified by Microwave Drying Method.

b. Testing laboratory shall perform a microwave oven drying test every day in which 50 cubic yards or more concrete is scheduled to be placed. Testing shall be repeated throughout the day for every 50 cubic yards that is placed. Concrete discharge from truck and placement will not be held up pending results of initial testing.

c. The testing laboratory shall follow AASHTO Standard Test Designation T318-02, "Water Content of Freshly Mixed Concrete Using Microwave Oven Drying," to determine water content and w/c ratio.

d. Testing laboratory will provide a sample calculation worksheet to show calculations of water content (WC) and water/cement ratio with absorption of fine and coarse aggregates being taken into account. Testing laboratory shall provide immediate reporting to the Contractor and the Owner's representative, followed by a formal written report.

e. Concrete which does not meet specified water/cement ratio shall be rejected. When concrete is determined to not meet specifications, additional testing will be required on subsequent trucks arriving on site, and discharge will not be permitted until consistent satisfactory results are obtained.

5. Air Content Test (Hardened Concrete)

a. The testing laboratory shall obtain core samples as directed by Engineer. The Contractor shall promptly assist testing laboratory by providing access, ladders, and/or scaffolding as needed to obtain samples. The testing laboratory shall core drill concrete and provide same-day patching of holes using non-shrink grout.

b. Samples shall be obtained 14 days after placement (immediately following the 7-day wet cure and 7 day drying out).

c. Hardened air content shall be determined in accordance with ASTM C457. Should any of these representative core samples show low air content, additional sampling and testing will be required and paid for by the Contractor. The Contractor will be responsible for replacement and/or corrective measures for concrete not meeting specification requirements.

d. Three cores shall be obtained at each location as specified below. At base slab locations, the three cores shall be obtained at random throughout the slab. At walls, one sample shall be taken near the base of the wall, one at mid-height, and the third near the top of the wall. Wall samples are to be taken from the inside of the tank.

3.12. ADDITIONAL TESTING FOR CONCRETE ACCEPTANCE

A. When unsatisfactory test results arise, additional tests as outlined below shall be provided and paid for by the Contractor.

B. Inadequate Compressive Strength - In the event that test results fail to meet the strength requirements as outlined above, the Contractor shall be responsible for costs associated with having concrete core specimens obtained from the affected area and tested.

Three cores shall be taken for each sample in which the strength requirements were not met. The drilled cores shall be obtained and tested in conformance with ASTM C42 by the Owner's independent testing laboratory.

A core specimen shall be taken perpendicular to the concrete surface and shall be taken from near the middle of a unit of deposit when possible and not near formed joints or obvious edges of a unit deposit.

The diameter of core specimens should be at least 4 inches. The length of specimen, when capped, shall be at least twice the diameter of the specimen. Core specimens shall not include reinforcement. On the same day as they are drilled, core holes shall be repaired with non-shrink grout.

The core specimens shall be carefully handled while transported to the laboratory. Cores shall be tested and evaluated in accordance with ASTM C442 and ACI 301, Chapter 1.6.7.

1. The concrete in question will be considered acceptable if the average of three core specimen compressive strength tests meet or exceed 85 percent of the specified strength required for the specific concrete mix. No individual core compressive strength test result shall fall below 75 percent of the specified strength.

2. Load Tests - If compressive strength requirements under the above procedure are not met by the results of core tests, then the Engineer may order load tests pursuant to ACI 318. Such tests shall be at the Contractor's expense.

C. Non-Compliant Air Content - In the event that concrete placed by the Contractor is suspected of, or is tested and shown to not have proper air content or erratic air test results are obtained as specified above, the Contractor shall engage an independent testing laboratory to obtain and test samples for air content in accordance with ASTM C457 and to recommend modification to mix components or additives. The Contractor will be responsible for remediation to the satisfaction of the Engineer/Owner.

3.13. TEST REPORTS

A. The testing laboratory shall provide a copy of field notes directly to Owner's on-site representative no later than the following day.

B. Compressive strength test results shall be submitted to the Owner’s on-site representative, Engineer, Contractor, and concrete supplier within 2 business days following 7-, 28-, and 56-day testing.

3.14. REPAIR OF NEWLY CAST CONCRETE

A. Areas of concrete in which cracking, spalling, or other signs of deterioration develop during initial curing or thereafter until the end of the guarantee period shall be removed and replaced, or repaired in accordance with this Article and Section 03732, Concrete Repair.

The Contractor may propose to use a specific method most suitable to the situation and have the method approved by the Engineer prior to repair. The Contractor shall submit manufacturer's product data sheets and recommended application procedures to the Engineer for approval prior to performing repairs.

B. Structural Cracks (as determined by Engineer) - Random shrinkage or structural cracks shall be repaired utilizing a low viscosity, 100 percent solids, two-component epoxy resin injection system as specified in Section 03732, Concrete Repair.

C. Leaking and/or Active Cracks (That Are Not Structural Cracks) - Leaking and active cracks shall be repaired utilizing a low viscosity, hydrophobic, closed cell polyurethane foam injection system as specified in Section 03732, Concrete Repair.

D. Excessive surface cracking in concrete slabs as defined herein shall receive a penetrating epoxy resin sealer to mend and seal the cracks as specified in Section 03732, Concrete Repair.

Excessive cracking shall be defined as areas containing "craze cracking" or "map cracking" as defined by ACI 201.1. In the event that excessive cracking occurs in isolated areas of a given concrete slab, sealer could only be required in the area of the cracks bounded by construction or control joints pending Engineer approval.

E. Damaged (spalled, weakened, or disintegrated) concrete and areas of honeycomb shall be removed to sound concrete and shall be repaired in accordance with Section 03732, Concrete Repair.

F. Substrength Concrete

1. Concrete which fails to meet the strength requirements as outlined above in Article 3.13 will be analyzed by the Engineer as to its adequacy based upon design loading and exposure conditions for the particular area of concrete in question.

2. If the concrete in question is found unacceptable based upon this analysis, that portion of the structure shall be strengthened or replaced by the Contractor at his expense. The method of strengthening or extent of replacement shall be as defined by the Engineer.

3. Concrete not requiring strengthening but still falling below the strength requirements, may be accepted by the Owner in accordance with the General Conditions, specifically the paragraph entitled "Acceptance of Defective Work."

G. Inadequate Air Content - Concrete which will be exposed to freeze-thaw cycles when in service, and which is found to have inadequate air content, shall be replaced to the extent defined by the Engineer.

END OF SECTION

SECTION 03350

CONCRETE FINISHES

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Concrete finishes.

B. Sample wall finish requirements and approvals.

C. ACI certification requirements.

D. Plugging of tie holes and patching of surface defects.

1.02. REFERENCES

The publications listed below form a part of this specification.

A. American Concrete Institute

1. ACI 117 - Specifications for Tolerances for Concrete Construction and Materials

2. ACI 301 - Specifications for Structural Concrete

3. ACI 303 - Guide to Cast-in-Place Architectural Concrete Practice

1.03. SUBMITTALS

A. Submit product data and manufacturer's installation instructions for the following:

1. Plug mortar for tie holes.

2. Grout rubbing mixture for minor surface defects.

B. Submit copy of finishing Contractor's ACI certification and/or experience record.

1.04. QUALITY ASSURANCE

A. Finishing foreman shall have ACI training and certification for concrete finishing and/or a minimum of five years' experience as a finishing concrete foreman.

PART 2 PRODUCTS

2.01. MATERIALS

A. Plug mortar shall be a fast-setting hydraulic cement compound that can immediately stop running water or seepage leaks in concrete. Use BASF Chemical Company "Waterplug," Euclid Chemical Company "Speed Plug," L&M Construction Chemicals, Inc. "Duraplug," or equal.

B. Grout rubbing mixture shall consist of 1 part Portland cement and 1-1/2 parts fine sand mixed to a thin grout consistency. The sand and the Portland cement shall be obtained from the concrete batch plant where the concrete was purchased and shall be the same used in the concrete.

C. Repair mortar for deep surface repairs (greater than 1-1/2 inches deep) in new construction is specified in Section 03300, Cast-In-Place Concrete.

PART 3 EXECUTION

3.01. CONCRETE FINISHES

The finish of all walls shall be described below and in accordance with the schedule at the end of this section. Exposed tops of walls shall be finished, as prescribed for slab and floor finishes.

A. As Cast Wall Finishes

1. Type I - Rough Form Finish - No select form facing materials shall be specified for rough form finish surfaces. Tie holes shall be filled with plug mortar. Honeycomb, voids, and other surface defects (including bug holes) greater than 3/4-inch wide and up to 1-1/2 inches deep shall be filled with grout rubbing mixture. Deeper repairs shall be accomplished using approved concrete repair mortar as specified in Section 03300, Cast-In-Place Concrete. Fins exceeding 1/4 inch in height shall be removed. Otherwise, surfaces shall be left with the texture imprinted by the forms.

2. Type II - Smooth Form Finish - The form facing material shall produce a smooth, hard, uniform texture on the concrete. It may be plywood, tempered concrete form grade hardboard, metal, plastic, paper, or other approved material.

   Material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which will impair the texture of the concrete surface shall not be used.

   The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to the practical minimum. It shall be supported by studs or other backing capable of preventing excessive deflection (see Section 03100, Concrete Formwork, for tolerances).

   Tie holes shall be plugged and all surface defects shall be patched as specified under Type I finish. All fins and irregularities shall be completely removed by grinding.

B. Rubbed Wall Finishes - The following finishes shall be produced on concrete with a Type II smooth form finish. Where smooth rubbed finish is to be applied, the forms shall have been removed and necessary patching completed as soon after placement as possible without jeopardizing the structure and taking into account the required curing and protection. Reference Section 03370, Concrete Curing and Protection.

1. Type III - New Concrete, Smooth-Rubbed Finish - New concrete is defined here as concrete less than seven days old. Maintain curing and protection during the finishing operations.

   a. Wet curing can be briefly interrupted for finishing as long as the concrete is not allowed to surface dry. Contractor shall be prepared to re-wet every 15 minutes or more often as needed.

b. The finishing shall be applied no later than the day following form removal (green concrete maximum seven days old). Surfaces shall be wetted and rubbed with a carborundum brick until uniform color and texture are produced.

c. No cement grout shall be used other than the cement paste drawn from the concrete itself by the rubbing process. Delayed application of Type III finish will not be accepted. A Type IV finish will be required.

2. Type IV - Old Concrete, Grout-Cleaned Rubbed Finish - Old concrete is defined here as concrete over seven days old that cannot be "green rubbed."

a. Concrete shall have completed seven days of curing per Section 03370, Concrete Curing and Protection.

b. Large areas more than 12 feet high or 24 feet long shall be marked off with chalk lines to produce a uniform overall pattern.

c. The surface shall be soaked with water. The surface being worked on shall not be in direct sunlight while finishing. Curing in direct sunlight is acceptable.

d. Immediately after soaking, apply the grout rubbing mixture with a rubber or cork float. The material is spread to form a thin paste over the area being worked on.

The applicator shall always work to a wet edge.

If the area starts to visually lighten up or dry, water can be added by shaking a wetted brush or using a pump sprayer to moisten the surface.

The coated area shall be permitted to set similar to waiting for a concrete floor to set.

e. The applicator shall use a carborundum brick or specialty power tool to vigorously work the material in a circular motion to a smooth rubbed finish.

f. It is not intended to leave a thin grout coating or a "swirl" or "fan" pattern visible on the wall.

g. Should the mixture start to dry out or get too stiff to work, the applicator may re wet the wall with either a pump or brush.

h. When the area is complete, it will be smooth and dark to medium grey in color. The smooth surface will be equal to a medium grade of sand paper with no "bug holes," globs, or excess material remaining.

i. When viewed from a distance about 20 to 30 feet, the concrete will appear to be a uniform grey, creamy smooth surface.

j. Grout-cleaned rubbed walls shall be further cured by immediately spraying the surface with liquid curing compound. The curing compound must have appropriate approvals as stated above in Part 2 or a wet cure shall be maintained as specified in Section 03370, Concrete Curing and Protection, for an additional three days.

C. Slab and Floor Finishes - The finish of all floors, slabs, flow channels, and tops of walls shall be described below and in accordance with the schedule at the end of this section. Reference Table 03350-1 at the end of this section for floor finishing tolerances.

1. Type A, Scratched Finish - After the concrete has been placed, consolidated, struck off, and leveled, the concrete shall be floated with a magnesium float.

   If any water has been brought to the surface by the float during rough finishing, floating operations shall not continue until this water is allowed to evaporate.

   Floating shall proceed when the water sheen has disappeared and the surface has stiffened sufficiently. During floating, planeness of surface shall be checked with a 10-foot straightedge applied at not less than two different angles.

   After floating to a Class C tolerance, the surface shall be roughened to a 1/4-inch amplitude with a coarse steel rake before final set.

2. Type B, Floated Finish - The procedure for a floated finish is the same as for Type A up to roughening the surface.

   The slab is floated, with all high spots cut down and all low spots filled to produce a surface with a Class B tolerance. The slab shall be finish floated to a uniform sandy texture.

   Tops of walls shall be finished with a Type B finish, except initial floating shall be followed immediately with a light trowel, being careful not to trowel in bleed water. If bleed water is present, Contractor shall wait for its evaporation before applying trowel finish.

3. Type C, Troweled Finish - The surface shall first receive a Type B floated finish. It shall next be power troweled, and finally hand troweled for thorough consolidation. The first troweling after power troweling shall produce a smooth surface which is relatively free of defects but which may still show some trowel marks. Additional trowelings shall be done by hand after the surface has hardened sufficiently.

   The final troweling shall be done when a ringing sound is produced as the trowel is moved over the surface.

   The finished surface shall be essentially free of trowel marks, uniform in texture and appearance and shall be plane to a Class A tolerance, except tolerance for tank base slabs shall be to a Class B tolerance.

   Apply only a light trowel finish, free of trowel marks, for concrete tank base slabs.

4. Type D, Broom Finish - First, finish the concrete with a Type B floated finish. The concrete shall be given a transverse scored texture by drawing a coarse broom across the surface, perpendicular to the line of travel along the walking surface.

D. Finishes for Bottom and Side Formed Surfaces Exposed to View

1. General - This includes the side and underside finishes of slabs, beams, columns, and other miscellaneous surfaces left exposed after form removal.

2. Finishes - These surfaces shall be finished to the same quality as scheduled for the wall surfaces in a given area. In the event there is no scheduled finish, all surfaces exposed to view shall receive the equivalent of a Type II finish.

E. Finish Schedules

1. Floor (Horizontal) Finishes - See Table 03350-1 for tolerances and Table 03350-3 for finish types.

2. Wall (Vertical) Finishes - See Table 03350-2.

3.02. TIE HOLES AND SURFACE DEFECTS

A. General - Repair Contractor-cast concrete, including tie holes and surface defects (honeycomb, large bug holes, pits, etc.) with surface areas greater than 3/4 square inch or 1/4-inch depth.

B. Tie holes shall be filled with specified plug mortar.

C. Surface defects less than 1-1/2 inches deep shall be removed down to sound concrete. If chipping is necessary, the edges shall be perpendicular to the surface or slightly undercut. No featheredges will be permitted.

1. The area to be patched and an area at least 6 inches wide surrounding it shall be dampened to prevent absorption of water from the grout rubbing mixture.

2. The quantity of mixing water shall be no more than necessary for handling and placing.

3. After surface water has evaporated, the grout rubbing mixture shall be applied.

4. The grout shall be consolidated into place and struck off so as to leave the patch slightly higher than the surrounding surface. To permit initial shrinkage, it shall be left undisturbed for approximately one hour before being finally finished.

5. The patched area shall be cured using a liquid curing compound. Metal tools shall not be used in finishing a patched area which will be exposed. Exposed surfaces shall be left uniform in appearance. Patching shall be completed prior to application of other specified surface finishes.

D. Surface defects greater than 1-1/2 inches deep shall be repaired using an approved concrete repair mortar as specified in Section 03300, Cast-In-Place Concrete.

TABLE 03350-1 FLOOR FINISHING TOLERANCES

A	eled finishes and troweled toppings shall be true planes within 1/8-inch in 10 feet, as determined by a 10-foot straightedge placed anywhere on the slab in any direction.
B	ed finishes shall be true planes within 1/4-inch in 10 feet, as determined by a 10-foot straightedge placed anywhere on the slab in any direction.
C	ch finishes and concrete fills shall be true planes within 1/4-inch in 2 feet, as determined by a 2-foot straightedge placed anywhere on the slab in any direction.

TABLE 03350-2 WALL (VERTICAL) FINISHES

Type I	Rough Form Finish - All concrete not exposed to view or not in contact with liquid. Below-grade walls not receiving dampproofing, waterproofing, or insulation.
Type II	Smooth Form Finish - The interior of all liquid containment structures (tanks, flow channels, etc.) and all concrete to be dampproofed or waterproofed, receive a coating system, and/or receive insulation.
Type III [(1)] (Exterior)	Smooth Rubbed Finish - Exterior exposed-to-view concrete wall areas and edges of slabs. This finish shall be carried to a minimum of 6 inches below finished grade.
Type III [(1)] (Interior)	Smooth Rubbed Finish - Interior exposed-to-view concrete wall areas, columns, curbs, equipment supports and pads, housekeeping pads, and all other surfaces notindicated to receive other finish.

[(1)] Unacceptable Type III finish areas shall be refinished with a Type IV grout-cleaned rubbed finish.

TABLE 03350-3 FLOOR (HORIZONTAL) FINISHES

Type A	Scratched Finish - For surfaces intended to receive bonded applied cementitious applications of Type G, Concrete Topping.
Type B	Floated Finish - At tops of walls and footings, for surfaces intended to receive roofing, and surfaces to receive and a Type D broom finish.
Type C	Troweled Finish - For all horizontal surfaces (including slabs and concrete toppings) not indicated to receive other finish. Apply a light troweled finish for tank (and channel) base slabs.
Type D	Broom Finish - For exterior walkways, exterior platforms, sidewalks, and other exterior walking surfaces.

END OF SECTION

SECTION 03370

CONCRETE CURING AND PROTECTION

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Curing and protection for all concrete slabs, other flatwork (including toppings, beams, etc.), and for all walls and other vertical members (including columns, grade beams, etc.) during:

1. Normal weather conditions.

2. Hot weather conditions.

3. Cold weather conditions.

B. Limited use of curing compound.

1.02. REFERENCES

The publications listed below form a part of this specification.

A. American Concrete Institute

1. ACI 305R - Hot Weather Concreting

2. ACI 306R - Cold Weather Concreting

3. ACI 308R - Guide to Curing Concrete

B. American Society for Testing Materials

1. ASTM C171 - Sheet Materials for Curing Concrete

2. ASTM C309 - Liquid Membrane Forming Compounds for Curing Concrete.

1.03. SUBMITTALS

A. Prior to placement of any concrete, submit an outline indicating various curing and protection methods and procedures intended for use on this project during each of the following conditions:

1. Normal weather conditions.

2. Hot weather conditions.

3. Cold weather conditions.

Include procedures for slabs (and other flatwork), walls (and other vertical members), and footings.

B. Submit single-page catalog cut for curing compound with fugitive dye specifically indicated.

C. Submit single-page catalog cut for polyethylene film with material selection specifically indicated.

1.04. COORDINATION

A. Contractor’s outlined curing and protection methods and procedures shall be approved prior to first concrete placement.

B. Coordinate curing, protection, and rubbed wall finish to occur simultaneously during the initial seven-day period after concrete placement. Reference Section 03350, Concrete Finishes.

C. Coordinate sequence of work to avoid loading or working on newly cast concrete for the first 24 hours.

D. The Owner's representative and/or Engineer shall make final determination of when hot weather or cold weather curing and protection requirements are in effect.

PART 2 PRODUCTS

2.01. CURING WATER

A. Water shall be potable.

B. Water shall be free of materials that have the potential to stain concrete.

2.02. CURING COMPOUNDS

A. Curing compound shall be a dissipating, VOC-compliant, water-based, liquid membrane-forming, including a fugitive dye, and conforming to ASTM C309, Type 1-D.

Use Conspec by Dayton Superior "Rx Cure WB," The Euclid Chemical Company "Tammscure WB 30D," W.R. Meadows, Inc. "1100-Clear," or equal.

B. Curing compound shall be applied at twice the manufacturer's recommended application rate.

2.03. POLYETHYLENE FILM

A. Polyethylene film shall be white (opaque) and shall meet the requirements of ASTM C171.

B. Polyethylene film used on this project shall be maintained in like new condition or shall be replaced. The Owner's representative shall have the final decision when condition of film becomes unacceptable.

2.04. ADMIXTURES

A. Accelerating admixtures associated with cold weather concrete are not allowed in Mix B concrete used for liquid containment structures. Refer to Section 03300, Cast-in-Place Concrete, for other concrete mixes that are allowed to consist of acceleration admixtures.

PART 3 EXECUTION

3.01. PREPARATION

A. All freshly placed concrete shall be protected from adverse weather and from defacement. As soon as the concrete has been placed and horizontal top surfaces have received their required finish, provisions shall be made for providing continuous curing and protection as required below.

3.02. NORMAL WEATHER CURING AND PROTECTION

A. Definition of Normal Conditions - All conditions not defined as either hot or cold weather.

B. Slabs and Other Flatwork

1. After finishing and immediately after the concrete surface has hardened enough to prevent dilution of the cement paste, provide continuous moist curing for at least the first 24 hours.

2. After the initial 24-hour period, cure for an additional 6 days with one of the following methods:

a. Cover with white polyethylene film.

b. Cover with burlap and continuous sprinkling with water.

c. Continuous water spray with no covering.

C. Walls and Other Vertical Members

1. Immediately after the concrete surface has hardened enough to prevent dilution of the cement paste, provide continuous moisture at the exposed top surface for at least the first 24 hours.

2. After the initial 24-hour period, cure for an additional six days with one of the following methods. (Note: For walls specified to receive a rubbed finish, forms must be removed and rubbed finish applied prior to the end of the seven-day curing period.

a. Leave forms in place, tight. Provide continuous moisture at the exposed top surface.

b. Leave forms in place; loosen after 24 hours. Provide continuous water at top of wall (or member) to soak all sides.

c. Remove forms; soak walls with water. Cover tightly with white polyethylene film.

d. Remove forms; cover with burlap and soak by continuous spray.

D. Strip Footings and Isolated Column Footings (Note: Strip footings include footings of foundation (frost) walls, retaining walls, and flood walls.)

1. After finishing, apply curing compound at twice the manufacturer's recommended application rate.

2. Curing compound shall be applied to and seamlessly cover all exposed surfaces.

E. For the first 24 hours after concrete finishing, no work shall commence nor shall any material be placed on concrete. The exposed concrete surfaces shall be protected from any potential damage with plywood or other means for the remaining six days of the curing period.

F. Interruptions, not to exceed a total of four hours are permitted for the purpose of layout, shoring or reshoring, finishing, or other required construction needs as long as the surface is not allowed to completely dry. Be prepared to spray the exposed surface every 15 to 30 minutes.

3.03. HOT WEATHER CURING AND PROTECTION

A. Conform to ACI 305R when concreting during hot weather except as modified below.

B. Definition of Hot Weather - When combinations of high air temperature, low relative humidity, and wind speed have the potential to cause the concrete to reach the critical evaporation rate (0.15 lbs/ft^2/h), the Contractor and his concrete supplier shall exercise precautionary measures in preparing, delivering, placing, finishing and curing of the concrete.

The Owner's representative and/or Engineer shall determine if hot weather conditions are in effect in accordance with ACI 305R. Note that it is possible to have hot weather conditions with air temperatures as low as 65 degrees F if low humidity and moderate wind speeds (10 mph or greater) exist. By default, when air temperatures exceed 80 degrees F, regardless of relative humidity levels and wind speed, hot weather conditions shall be in effect.

C. Temperature of fresh concrete shall not exceed 90 degrees F. Concrete delivered at temperatures exceeding 90 degrees F shall be rejected.

D. Curing of the concrete shall begin immediately after completion of the initial finishing operation.

1. Slabs and Other Flatwork - After the initial 24-hour period of moist curing, continue wet cure for an additional six days with one of the following:

   a. Soak with water and cover with white polyethylene film.

   b. Cover with burlap and continuous sprinkling with water.

2. Walls and Other Vertical Members - After the initial 24-hour moist curing, continue wet cure for an additional six days with one of the following. (Note: See normal weather curing above for coordination of rubbed wall finish.)

   a. Leave forms in place, tight with soaker hose on top.

   b. Leave forms in place; loosen after 24 hours. Provide continuous water or double soaker hoses on top.

   c. Remove forms; soak walls with water. Cover tightly with white polyethylene film over soaker hose at top of wall.

3. Strip Footings and Isolated Column Footings (Note: Strip footings include footings of foundation (frost) walls, retaining walls, and flood walls.)

a. After finishing, apply curing compound at twice the manufacturer's recommended application rate.

b. Curing compound shall be applied to and seamlessly cover all exposed surfaces.

c. After applying curing compound, completely cover the concrete with white polyethylene film.

E. Monitor concrete temperature for walls and slabs 20 inches thick or more. After temperature has peaked, control rate of cooling to ambient temperature at a rate of 1 degree F per hour to prevent cracking.

F. For the first 24 hours after concrete finishing, no work shall commence nor shall any material be placed on concrete. The exposed concrete surfaces shall be protected from any potential damage with plywood or other means for the remaining six days of the current period.

G. Interruptions, not to exceed a total of four hours are permitted for the purpose of layout, finishing, or other required construction needs as long as the surface is not allowed to completely dry. Be prepared to spray the exposed surface every 15 to 30 minutes.

3.04. COLD WEATHER CURING AND PROTECTION

A. Conform to ACI 306R when concreting during cold weather except as modified below.

B. Definition of Cold Weather - A period when for more than three consecutive days the average daily temperature drops below 40 degrees F. When temperatures above 50 degrees F occur during more than half of any 24-hour period, the concrete shall no longer be regarded as cold weather concrete. The Owner's representative shall monitor daily temperatures for determination of start and stop of cold weather concreting. Contractor shall comply with this determination.

C. The methods of curing and protecting the concrete shall be such as will prevent drying or freezing. Labor, equipment, and materials necessary for cold weather curing and protection (including heating) shall be on the site and set up (staged) in sufficient quantity before concrete placement begins.

D. Concrete must be cured and protected from cold weather simultaneously.

E. For the first 24 hours after concrete finishing, no work shall commence nor shall any material be placed on concrete. The exposed concrete surfaces shall be protected from any potential damage with plywood or other means for the remaining duration of the curing and protection period.

F. Curing

1. Slabs and other flatwork shall be cured with one of the following:

a. Coat with curing compound applied at twice the recommended manufacturer's application rate.

b. Cover with polyethylene film.

2. Walls and other vertical members shall have forms left in place, tight for the first 24 hours. Apply twice the application rate of curing compound to the exposed top surface or cover with polyethylene film. After the initial 24-hour period, cure for an additional six days with one of the following:

   a. Leave forms in place, tight as above.

   b. If forms are loosened, immediately remove forms and either: (1) apply curing compound at twice the manufacturer's recommended application rate to all surfaces; or (2) cover tightly with polyethylene film.

   (Note: Coordinate with rubbed wall finish requirements.)

G. Protection

1. Protection shall proceed as follows:

   a. For Slabs and Other Flatwork

      1) Cover with blankets and/or heated enclosure as required.

   b. For Walls and Other Vertical Members (Note: Extra effort will be required to prevent freezing when using water to complete rubbed wall finishing.)

      1) Forms Left in Place, Not Loosened - Cover with blankets and/or heated enclosure as required.

      2) Forms Removed Prior To End Of Protection Period - Re-cover with blankets and/or heated enclosure as required.

2. The length of the protection period for each type of member shall be as determined in the table below.

Cold Weather Protection Period				
Type of Member	**Service Category**	**Temperature Range**	**Type I or II Cement (Days)**	**Type III Cement (Days) (1)**
Slab-On Grade	3	50°F – 70°F	6	4
Columns	3	50°F – 70°F	6	4
Walls (2)	3	50°F – 70°F	6	4
Walls(3)	4(4)	50°F – 70°F	21 (5)	14 (5)
Beams	4(4)	50°F – 70°F	21 (5)	14 (5)
Slabs (Other)(6)	4(4)	50°F – 70°F	21 (5)	14 (5)

(1) Obtain written approval by the Engineer for the use of Type III cement or an acceleration admixture.
(2) Walls that will not be service loaded (leak tested or backfilled) for at least 60 days after placement.
(3) Walls that are to be service loaded soon after concrete placement.
(4) Formwork shall remain in place until the end of the protection period for Service Category 4 structural members.
(5) Protection period could be shortened based on concrete achieving at least 80 percent of the required design strength as determined by testing of field-cured cylinders.
(6) All structural slabs supported by temporary formwork.

H. Suitable means shall be provided for maintaining the deposited concrete within the temperature range as defined above. Curing provisions as stated above must be in place prior to exposing concrete to heat.

Heating may be provided by using a vented heating unit, insulated blankets, or a combination of both.

1. If blankets are to be used, they should be applied to the concrete as specified in ACI 306R, Chapter 7, Charts 7.3.1-7.3.4. Special attention should be given to corners and edges of concrete members which could require about three times the thickness of insulation to maintain concrete temperature, as compared to thickness that might be required for interior spaces. Also note that excessive amounts of blankets could raise the temperature of the concrete too high which could cause an increase of thermal shrinkage and cause cracking due to thermal shock.

2. Where heated enclosures are provided, vent flue gases from combustion heating units to the outside of the enclosure. Place and direct heaters to avoid areas of overheating or drying of the concrete surface. Exposed concrete surfaces must be protected and cured. Where continuous moist curing is not practical, tightly adhered polyethylene or curing compounds shall be used.

I. Monitoring of Concrete Temperatures

1. In order to adjust and maintain cold weather procedures, various thermometers (supplied and maintained by the Contractor) shall be placed along concrete members that are undergoing cold weather protection, particularly at corners and edges of concrete members where it is more difficult to maintain the required temperature.

2. Monitoring of these temperatures must be done throughout the day, taking into account forecasted night conditions. Make timely adjustments to maintain an even temperature.

   At a minimum, temperatures shall be recorded at start of work in the morning, at noon, and at end of work day (but early enough to have time to make necessary adjustments to cold weather protection).

3. Access to these thermometers must be made available for the Owner's representative to perform spot-checking of the Contractor's effectiveness to achieve proper cold weather protection.

4. Provide the proper type and sufficient quantity of thermometers to determine the temperature of the concrete. As a minimum, provide, locate, and maintain at least one Hi-Low thermometer and at least two surface thermometers for each placement of concrete which is simultaneously undergoing cold weather curing and protection.

J. Interruptions to Protection

1. Measures shall be taken to assure the concrete temperatures will not drop below 32 degrees F.

2. Interrupted time must be made up in accordance with ACI 306R, Section 7.7. Time lost from required period of protection shall be made up with twice the number of lost degree hours.

K. After the required protection period listed in the above table, concrete shall have curing coverings removed and be allowed to gradually dry out prior to lowering temperatures to freezing as described in the following table.

Maximum Concrete Temperature Drops at End of Protection Period	
Thickness of Section, Inches	**Maximum Gradual Decrease in Surface Temperature During Any 24 Hours After End of Protection, °F**
Less than 12	50
12 to Less than 36	40
36 to 72	30
Greater than 72	20

3.05. FINAL CONCLUSION OF CURING PROTECTION PERIODS

A. At the conclusion of curing and protection periods, all concrete surfaces shall be washed down to remove all debris and laitance material.

B. Complete removal of curing compounds will be required prior to application of coatings or other toppings. A light abrasive blast or other mechanical means may be required.

END OF SECTION

SECTION 03600

GROUT

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Non-shrink grout for setting of equipment, column baseplates, precast units, and other accessories.

B. Non-shrink grout to patch voids around slab and wall penetrations.

1.02. REFERENCES

The publications listed below form a part of this specification.

A. American Concrete Institute

1. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete

2. ACI 309 - Practice for Consolidation of Concrete

B. American Society for Testing and Materials

1. ASTM C31 - Method of Making and Curing Concrete Test Specimens in the Field

2. ASTM C109 - Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch or 50 mm Cube Specimens)

3. ASTM C143 - Test Method for Slump of Portland Cement Concrete

4. ASTM C150 - Portland Cement

5. ASTM C1019 - Standard Method of Sampling and Testing Grout

6. ASTM C1107 - Packaged Dry, Hydraulic-Cement Grout (Non-shrink)

1.03. SUBMITTALS

A. Submit catalog cut for non-shrink grout.

PART 2 PRODUCTS

2.01. GROUT

A. Non-Shrink Grout - Shall be a flowable, non-staining, premixed, cement-based, manufactured product, requiring only the addition of water or latex mix solution (supplied by the grout manufacturer) at the job site.

1. For support of equipment and column baseplates, for setting of precast units or other accessories, and for plugging voids around slab and wall penetrations, use grout specifically manufactured for such applications.

Provide Engineer with manufacturer's certification for the uses intended, including 2-inch by 2-inch grout cube strength tests in accordance with ASTM C109. Plastic consistency of grout shall achieve minimum compressive strength of 5,000 psi in 7 days and 7,000 psi in 28 days.

2. Non-shrink grout shall be applicable for damp, corrosive environments.

B. Grout for patching and plugging concrete surfaces shall be as specified in Section 03300, Cast-in-Place Concrete.

C. Grout for reinforced masonry shall be as specified in 04900, Masonry Alterations and Repairs.

D. Adhesive anchor systems shall be used to install all bolts, anchors, and reinforcing bar dowels into concrete and/or masonry, as specified in Section 05505, Concrete And Masonry Anchors.

PART 3 EXECUTION

3.01. INSTALLATION

A. Prepare surfaces, mix product, and install grout per manufacturer's instructions.

B. Provide curing of the grout per manufacturer's recommendations.

END OF SECTION

SECTION 03732

CONCRETE REPAIR

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Preparation of concrete and application of repair materials for cracks, spalls, and deteriorated concrete.

B. Repair of failed joint waterstops.

C. Repair to reinforcement at saw cut concrete.

D. Repair to removed anchor bolts.

E. Repair to existing concrete damaged by Contractor.

1.02. REFERENCES

A. ACI 201.1 - Guide for Conducting a Visual Inspection of Concrete in Service.

B. ASTM A615 - Deformed Steel Bars for Concrete Reinforcement.

C. AWS D1.4 - Structural Welding Code for Reinforcing Steel.

1.03. COORDINATION

A. Contractor shall send a copy of this specification to repair product manufacturers.

B. Contractor shall coordinate with the repair product manufacturer's representative to visit the site prior to submitting written repair recommendations and final product selection.

C. Contractor shall consult with the Owner's representative in the field prior to and during the repair procedures to determine extent of repairs.

D. The product manufacturer's representative shall be made available for consultation with the Contractor or Owner's representative about the proper application during the repair procedures.

E. Color of selected coating system(s) shall match existing concrete. Owner shall determine acceptability of proposed color prior to application.

1.04. SUBMITTALS

A. Submit manufacturers' custom written repair recommendations and outline procedures based on product manufacturers' representative's site visit, verified and signed by the Contractor.

B. Submit single-page product data sheets (catalog cuts) to confirm product selection along with single-page custom written outline installation instructions for proposed repair materials.

C. Submit certification from product manufacturer attesting to approved Contractor status.

D. If the Contractor elects to propose a substitute repair product manufacturer for approval, all of the above items shall be submitted for approval along with at least two references from completed projects with similar repairs. These references shall include project and name with phone numbers of the Owner's representative able to attest to quality of the repairs performed on that project.

1.05. QUALITY ASSURANCE

A. Product Manufacturer - Company specializing in manufacturing the repair products specified in this section.

B. Applicator - Contractor specializing in concrete repair. The Contractor shall be approved by the manufacturer of the specified product, and have completed a program of instruction in the use of the specified repair material.

C. Contractor and product manufacturer shall propose final product recommendations based on experience and current project conditions.

1.06. DELIVERY, STORAGE, AND HANDLING

A. Comply with instructions for storage, shelf life limitations, and handling of repair products.

PART 2 PRODUCTS

2.01. MANUFACTURERS

A. Sika Corporation.

B. Euclid Chemical Company.

C. BASF Chemical Company.

D. Or equal.

2.02. MATERIALS

A. General Concrete Repair including Spalls, Delamination, and Deteriorated (Damaged) Concrete

1. Sika Corporation Products

a. Concrete and exposed reinforcement shall be coated with Sika Armatec 110.

b. Shallow Concrete Loss (Less Than 3 Inches Deep)

1) For vertical surfaces, use a polymer-modified repair mortar such as Sika Top 123 Plus.

2) For horizontal surfaces (tops of walls), repair with Sika Top 122.

c. Deep Concrete Loss (More Than 3 Inches Deep) – Repairs can either be built up in layers of the appropriate repair mortar used for shallow repairs, or by form-and-pour method using SikaTop 111 Plus.

2. Euclid Chemical Company Products

    a. Concrete and exposed reinforcement shall be coated with Duralprep A.C. rust inhibitor primer.

    b. Shallow Concrete Loss (Less Than 3 Inches Deep)

        1) For vertical surfaces, use a polymer-modified repair mortar such as Duraltop Gel.

        2) For horizontal surfaces (tops of walls), repair with Duraltop Fast Set.

    c. Deep Concrete Loss (More Than 3 Inches Deep) – Repairs can either be built up in layers of the appropriate repair mortar used for shallow repairs, or by form-and-pour method using Euco Crete Supreme.

3. BASF Chemical Company Products

    a. Concrete and exposed reinforcing steel shall be coated with Emaco P24.

    b. Shallow Concrete Loss (Less Than 3 Inches Deep)

        1) For vertical surfaces, use a polymer-modified repair mortar such as HB2 Repair Mortar.

        2) For horizontal surfaces (tops of walls), repair with HB2 Repair Mortar.

    c. Deep Concrete Loss (More Than 3 Inches Deep) – Repairs can either be built up in layers of the appropriate repair mortar used for shallow repairs, or by form-and-pour method using Emaca FS.

4. Or equal.

B. Repair of Concrete Structural Cracks (Dry and Not Leaking)

1. Sika Corporation Products

    a. Horizontal Surfaces - Use Sikadur 35, Hi-Mod LV epoxy resin gravity feed into cracks until filled.

    b. Vertical Surfaces - Use Sikadur 35, Hi-Mod LV epoxy resin injected into the crack with Sikadur 31 used as an exterior seal.

2. Euclid Chemical Company Products

    a. Horizontal Surfaces - Use Duralith LV gravity feed into cracks until filled.

    b. Vertical Surfaces - Use Duralith LV epoxy resin injected into the crack with Duralcrete Gel used as an exterior seal.

3. BASF Chemical Company Products

    a. Horizontal Surfaces - Use Concresive Standard LVI gravity feed into cracks until filled.

b. Vertical Surfaces - Use Concresive Standard LVI epoxy resin injected into the crack with Concresive Paste SPL used as an exterior seal.

4. Or equal.

C. Repair of Concrete Active (Moving) Cracks (Dry or Leaking)

1. Sika Corporation - Use SikaFix HH+/HH LV hydropobic, polyurethane grout injected into the crack.

2. Euclid Chemical Company - Use Dural Aqua-Fil hydrophilic polyurethane compound injected into the crack.

3. BASF Chemical Company – Use Concresive 1210/1230 IUG, hydrophilic polyurethane injected into the crack.

4. Or equal.

D. Repair of Excessive Surface Cracking in Slabs - Excessive cracking shall be defined as areas containing “craze cracking” or “map cracking” as defined by ACI 201.1.

1. Sika Corporation - Use Sikadur 55 SLV, epoxy resin penetrating sealer, gravity fed into the cracks.

2. Euclid Chemical Company - Use Dural 50 LM, acrylated epoxy resin penetrating sealer, gravity fed into the cracks.

3. BASF Chemical Company – Use EpoXeal GS Structural two-component epoxy penetrating sealer, gravity fed into the cracks.

4. Or equal.

E. Concrete Joint Sealant

1. For process tanks and other submerged conditions, use a polyurethane sealant designed for submerged conditions to either contain or hold out liquids. Provide sealant as specified in Section 03250, Concrete Joints and Accessories.

2. For non-submerged conditions, provide sealant as specified in Section 07900, Joint Sealants.

2.03. REINFORCEMENT MATERIALS

A. Steel Reinforcing Bars - ASTM A615, Grade 60, deformed bars.

B. Splicing Sleeves - Mechanical wedge type; “Quick-Wedge” manufactured by ERICO Concrete Construction Products or equal.

PART 3 EXECUTION

3.01. EXAMINATION

A. The Contractor shall coordinate with the Owner’s representative to determine which areas will be repaired and the extent of those repairs.

B. Verify that surfaces are ready to receive work.

C. Beginning of installation means installer accepts existing conditions.

3.02. PREPARATION

A. General Concrete Repairs Including Spalls, Delamination, and Deteriorated (Damaged) Concrete

1. To remove weak, spalled, delaminated, or other unsound concrete, use a 20-lb. chipping hammer.

2. At exposed reinforcing steel, abrasive blast to remove rust. Remove enough concrete around reinforcing bars to provide access. Splice in new reinforcing if section loss is more than 15 to 25 percent or as determined by Owner's representative.

3. Abrasive blast all concrete areas to be repaired to obtain surface profile as recommended by product manufacturer.

4. Saw cut as required to avoid feather edging of repair material and to provide a neat, finished appearance.

5. Use high pressure water to clean areas prior to repairs.

6. Use polymer-modified repair products installed per manufacturer's recommendations.

7. At areas to be coated, use either a brush-off blast or high pressure water blast at 4,000 to 6,000 psi to remove all existing tank coatings and surface contaminants and to prepare surface for coating. Remaining coatings and surface contaminants not removed by blasting shall be removed by other mechanical means, including grinding.

B. Structural Cracks (Dry and Not Leaking) - Structural cracks (determined by Engineer) shall be repaired utilizing a low viscosity, 100 percent solids, two-component epoxy resin system. Remove all dust, debris or disintegrated material from crack by use of oil-free compressed air or vacuuming, or by other approved methods as may be required by manufacturer.

Crack must be dry at time of application.

1. Horizontal Surfaces - "Vee" out cracks in the concrete surface. Apply epoxy in accordance with manufacturer's recommendations.

2. Vertical Surfaces - Patching of vertical wall cracks shall be accomplished by pressure injection of epoxy resin, as recommended by the repair materials manufacturer.

3. Provide temporary entry ports spaced to accomplish movement of fluids between ports. Limit port size diameter to be no greater than the thickness of the crack. Provide temporary seal at concrete surface(s) to prevent leakage of epoxy resin.

C. Active (Moving) Cracks (Dry or Leaking) – Moving and/or leaking cracks (determined by Engineer) shall be repaired utilizing a low viscosity, hydrophobic or hydrophilic, closed cell polyurethane compound injection system that will function as a flexible gasket.

1. Lightly grind crack surface to remove efflorescence and to expose/open up the face of the crack.

2. Starting 6 inches away from the crack, drill injection holes at 45 degrees to intersect the crack at about mid-depth of concrete member, but at least a minimum of 6 inches deep from the crack surface. Holes shall be placed alternating along sides of crack.

3. Provide temporary entry ports in these drilled holes spaced 12 to 18 inches or as required to accomplish movement of fluid between ports. It may be necessary to decrease the spacing of entry ports to properly inject the polyurethane compound.

D. Excessive surface cracking in concrete slabs shall receive a penetrating epoxy resin sealer to seal the cracks.

1. Pressure wash the existing concrete surface and clean out the cracks.

2. “Vee” out cracks in the slab surface as recommended by repair material manufacturer.

3. Surface preparations shall be in accordance with the manufacturer’s recommendations.

In the event that excessive cracking occurs in isolated areas of a given concrete slab, sealer could only be required in the area of the cracks bounded by construction or control joints

E. Concrete Joint Sealants – Remove all existing sealants (and backer rods) and abrasive blast to clean out concrete joints.

3.03. APPLICATION

A. Repair Mortar (Trowel Applied)

1. Trowel apply mortar mix. Tamp into place, filling voids at honeycomb and spalled areas.

2. Bring surface flush with surrounding area. Finish trowel surface to match surrounding area.

3. Cure per manufacturer’s specifications.

B. Repair Mortar (Form-and-Pour)

1. Provide rigid forms around the repair areas to receive pourable repair mortar.

2. Pour repair mortar into the forms. Tamp and vibrate as needed to eliminate the creation of air voids.

3. Bring surface flush with surrounding area. Finish trowel exposed surface(s) to match surrounding area.

4. Cure per manufacturer’s specifications.

5. Rub the cured repair surface to blend in with existing surrounding unrepaired surfaces.

C. Crack Injection of Epoxy Resin and Polyurethane Compound

1. Inject material into prepared ports under pressure using automated equipment appropriate for application.

2. For polyurethane injections, inject water into the crack to thoroughly flush out the crack to remove dirt, dust, and contaminants. Follow flush water by injecting polyurethane compound (with accelerating catalyst as required.)

3. Begin injection at lower entry port and continue until fluid appears in adjacent entry port. Continue from port to port until entire crack is filled.

4. Remove temporary surface seal (if applicable) and excess injection material. Grind surface as needed.

5. Clean surfaces of repair area and blend finish with surrounding area.

D. Excessive Surface Cracking

1. Prime surface as required by product manufacturer.

2. Apply product over surface and squeegee into the cracks.

3. Remove excess material from surface and/or broadcast aggregate into product to create a non-slip surface.

4. Mixing, application and finishing of product shall be in accordance with the manufacturer's recommendations.

E. Concrete Joints - Clean out and reseal all existing construction and/or control joints.

F. Saw Cut Concrete - At all areas on the project, after saw cutting concrete, repair exposed reinforcement as follows:

1. Chip back concrete around rebar end.

2. Cut off exposed reinforcement minimum 1-1/2 inches beyond concrete surface.

3. Prepare surface to a saturated, surface-dry condition and patch hole with plug mortar.

G. Repair to Removed Anchor Bolts – Existing exposed anchor bolts that are no longer used shall be cut off and patched in the same manner as the repair of exposed reinforcement in saw cut concrete (indicated above).

3.04. QUALITY CONTROL

A. The Contractor shall:

1. Coordinate to have the manufacturer's representative on site during installation to offer inspection and technical guidance.

2. Maintain suitable temperature throughout application.

3. Cure products following manufacturer's recommendations.

END OF SECTION

SECTION 04900

MASONRY ALTERATIONS AND REPAIRS

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Construction of new masonry openings to receive doors, glazed assemblies, louvers, vents or other items that require openings wherever shown on the Drawings. Work includes:

1. Temporary support of existing masonry and adjacent construction as needed.

2. Installation of new concrete and brick masonry to create finished masonry openings, including cutting, fitting and toothing in.

B. Repair of existing masonry damaged by demolition or construction activities, and filling of voids as required to permit proper installation of new work.

C. Chemical cleaning of exterior masonry and concrete surfaces.

D. Replacement of masonry and repointing of existing mortar joints.

1.02. REFERENCES

ACI 530	Building Code Requirements for Masonry Structures and Related Commentaries
ACI 530.1	Specification for Masonry Structures and Related Commentaries
ASTM A82	Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A1008	Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High- Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM A951	Standard Specification for Masonry Joint Reinforcement
ASTM C67	Standard Specification for Sampling and Testing Brick and Structural Clay Tile
ASTM C90	Standard Specification for Loadbearing Concrete Masonry Units
ASTM C140	Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
ASTM C216	Specification for Facing Brick (Solid Masonry Units made from Clay or Shale
ASTM C270	Standard Test Method for Mortar for Unit Masonry
ASTM C476	Standard Specifications for Grout for Masonry
ASTM C780	Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C979	Standard Specification for Pigments for Integrally Colored Concrete
ASTM C1019	Standard Test Method for Sampling and Testing Grout
ASTM C1093	Standard Practice for the Accreditation of Testing Agencies for Masonry
NCMA	National Concrete Masonry Association

1.03. PRECONSTRUCTION SUBMITTALS

A. Obtain written approval of submittals prior to use of the materials. Submit all masonry materials and accessories as one submittal. Incomplete submittals will be returned “Revise and Resubmit.”

B. Provide test results from an independent laboratory certified according to ASTM C1093 or employing technicians with a current “Certification in Concrete Masonry Testing” by the National Concrete Masonry Association.

1. All required data shall be dated within 24 months or less prior to the date the submittal is received by the Engineer.

C. Provide sampling, test data, and certificates for CMU.

1. Submit ASTM C140 test reports demonstrating compliance with ASTM C90.

2. Samples obtained for ASTM C140 tests shall have the same configuration, dimension, concrete mix, and curing methods as CMU proposed for use in building construction. Test results for 8 x 8 x 16 stretcher units are sufficient.

D. Provide test results for brick units.

1. Submit test results per ASTM C216 and ASTM C67 for the following:

a. Grade of brick units.

b. Initial rate of absorption.

c. Compressive strength.

d. Testing for water absorption.

e. Dimensional tolerances.

2. Samples used in ASTM C67 tests shall have the same composition, method of manufacture, configuration and dimension as brick proposed for use in the project.

E. Factory Premixed Mortar - For each type of mortar that is proposed for use in the project, submit test results from a certified laboratory demonstrating that the mortar mix meets the property specification requirements of ASTM C270.

F. Factory Premixed Grout - Provide test data for grout mix demonstrating compliance with ASTM C476 and showing the compressive strength from ASTM C1019 testing.

G. Provide manufacturer’s product data sheets for all products listed under Article 2.07 of this section. Product data sheets shall be clearly marked up by Contractor indicating selected items that conform to Drawings and Specifications. Mark the relevant item description, model number, material type, size, etc. as appropriate for the type of product.

H. Provide banded stacks (minimum five-brick stack) of actual samples of proposed brick matching existing adjacent building. Samples shall demonstrate color, texture, and blend match.

1.04. SUBMITTALS DURING CONSTRUCTION

A. Provide field evaluation tests required by Article 3.01 of this section as separately numbered submittals for each day that samples are taken.

B. Submit test data for field evaluation tests to the Engineer within 10 days of receipt of the test data by the Contractor.

1.05. QUALITY ASSURANCE

A. Perform work in accordance with ACI 530, 530.1, listed references, and this specification.

B. Where conflicts occur between current referenced publications and this specification, the more restrictive requirements shall apply.

C. Failure to detect defective work or material does not prevent later rejection.

1.06. REGULATORY REQUIREMENTS

A. Where fire-resistance ratings for walls are shown on Drawings, walls are to be designed to provide the required fire resistance by a method acceptable to the 2015 International Building Code including calculated fire resistance per Section 722 of the Code and ACI 216.

1.07. ENVIRONMENTAL REQUIREMENTS

A. Adhere to ACI 530.1, Part 1.8 C, “Cold Weather Construction,” when the ambient temperature or the temperature of masonry units is 40 degrees F or less.

B. Adhere to ACI 530.1 Part 1.8 D, “Hot Weather Construction,” when ambient temperature is 90 degrees F or greater.

1.08. DELIVERY, STORAGE, AND HANDLING

A. Inspect masonry units for damage. Return damaged units exceeding ASTM standards.

B. Store to permit air circulation while preventing moisture intrusion.

C. Accept factory premixed mortar or grout only in unbroken, labeled packaging. Return hardened, partially set, caked, contaminated, or deteriorated materials.

D. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.10. SEQUENCING AND SCHEDULING

A. Coordinate work with related products, including those listed in Article 1.02 of this specification.

PART 2 PRODUCTS

2.01. MANUFACTURERS - CONCRETE MASONRY UNITS

A. Clayton Block Co Inc., Arlington, NJ

B. Cranesville Block Co., Rock Tavern, NY

C. Or equal NCMA member plant.

2.02. CONCRETE MASONRY UNITS

A. Hollow and Solid Load Bearing Block Units - ASTM C90, normal weight, 1900 psi compressive strength.

B. Standard Block Units - ASTM C90, 1900 psi compressive strength - (maximum absorption 8 percent); Standard gray color.

C. Size and Shape – Provide standard hollow blocks for running bond installation, and special units as listed below:

1. Jamb Blocks – 8-inch long and 16-inch long units to provide flat and smooth face surrounding openings.

2. Bond Beam Units - 8 inches high with knock-out webs, stacked to create the height shown on drawings.

3. Lintel Units - 8 inches high or 16 inches high with solid bottoms and open ends or as shown on the Drawings.

4. Solid Units – Nominal 2-, 4-, and 6-inch thick units without cores for use where shown on Drawings.

2.03. BRICK UNITS

A. Face Brick – ASTM C216, Grade SW.

B. Size, texture, color, color variation and shape to match the face bricks of the existing structure.

2.04. FACTORY PREMIXED MORTAR

A. Provide factory premixed mortar, including all ingredients except water, for use with concrete masonry units and face brick.

B. Premixed products manufactured by:

1. The Quikrete Companies, Atlanta, GA.

2. Spec Mix, Inc., Eagan, MN.

3. Or equal.

C. ASTM C270 Type N for use with clay brick.

D. ASTM C270 Type S for use with concrete masonry units.

E. Antifreeze compounds are prohibited.

F. Admixtures containing chlorides are prohibited.

G. If mortar that will be exposed to view at the completion of construction requires the addition of color to provide a reasonable match to the existing adjacent mortar, use mineral oxide pigments compliant with ASTM C979.

1. Solomon Grind-Chem Service, Inc.

2. Davis Colors.

3. Or equal.

2.05 FACTORY PREMIXED GROUT

A. Provide factory premixed grout, including all ingredients except water, for use in concrete masonry wall bond beams, grouted vertical cores and masonry lintels.

1. Use fine grout where the dimension of the void to be filled, in any direction, is less than 4 inches.

B. Provide mortar mix design is to complying with ASTM C476 with a minimum 28-day compressive strength of 3,000 psi at 28 days.

1. Core Fill Grout by The Quikrete Companies, Atlanta, GA.

2. Core Fill Grout by Spec Mix, Inc., Eagan, MN.

3. Or equal.

2.06. MANUFACTURERS - REINFORCEMENT, ANCHORAGE, FLASHINGS, AND ACCESSORIES

A. Wire-Bond, Inc., Charlotte, NC.

B. Hohmann & Barnard, Inc., Hauppauge, NY.

C. Or equal.

2.07. ANCHORAGE, FLASHINGS, AND ACCESSORIES

A. Anchorage

1. Provide veneer tie system with rectangular or triangular wire ties mounted to backup masonry by a system that accommodates insulation thickness and allows for vertical movement.

2. All steel components are to be hot dip galvanized after fabrication per ASTM A153.

a. Wire components to be cold drawn steel wire conforming to ASTM A82; 80,000 psi tensile strength; 70,000 psi yield point.

b. Sheet metal components to be carbon steel meeting ASTM A1008.

B. Weeps to be cell vent type, equal to Wire-Bond #3601 or Hohmann & Barnard Quadro-Vent in the standard available color that most closely matches the mortar color.

C. Mortar Drip Suspension Device - Open matrix with staggered top profile of at least 1-inch thickness, equal to Wire-Bond #3611 or Hohmann & Barnard Mortar Trap.

D. Flashing - Self-adhesive composite sheet type with adhesive layer and polyethylene sheeting, equal to Wire-Bond Aqua Flash 500 or Hohmann & Barnard TeXtroflash. Provide termination bar, primers and other materials required for proper installation.

E. Joint Sealers - As specified in Section 07900, Joint Sealants.

2.08. REBUILDING

A. Cut out damaged and deteriorated masonry with care in a manner to prevent damage to any adjacent remaining materials.

B. Needle, shore, or support structure as necessary in advance of cutting out units.

C. Mortar Mix - Colored to match existing work.

2.09. REPOINTING

A. Cut out loose or disintegrated mortar in joints to a 1-inch depth without damage of chamfering of masonry edges.

B. Utilize hand tools and power tools only after test cuts determine no damage to masonry units will result.

C. When cutting is complete, remove dust and loose material by brushing.

D. Pre-moisten joint and apply mortar. Pack tightly in maximum 1/4-inch layers. Joints to match existing.

E. Moist cure for 72 hours.

2.10. RESTORATION CLEANING

A. Clean surfaces and remove large particles with wood scrapers or non-ferrous wire brush or .

B. Brush coat masonry with restoration cleaner, mixed into solution in strict accordance with manufacturer’s instructions.

C. Provide a second application if required by preliminary test of sample area.

D. Cleaning Agent - Detergent or solvent cleaner.

1. Prosoco – Sure Klean 600.

2. EaCo Chem - NMD 80.

2.11. WATER RESISTIVE COATING

A. Apply water-resistive coating to all existing and new masonry surfaces.

B. Manufacturers

1. Sherwin Williams – Loxon 40% Silane Water Repellant A31 T 40.

2. H&C - SL-40 Water Repellent.

3. Euclid Chemical - Baracade Silane 40.

PART 3 EXECUTION

3.01. FIELD EVALUATION TESTING

A. Field testing shall be scheduled by the Contractor and paid for by the Owner.

B. Provide test results from an independent laboratory certified according to ASTM C1093 or employing technicians with a current “Certification in Concrete Masonry Testing” by the National Concrete Masonry Association.

C. Tests Required

1. Collect and test one set of mortar samples for each day mortar is used on the project.

2. Collect and test separate samples for each type of mortar used on any particular day.

3. Collect and test one set of grout samples for each day grout is used on the project.

4. Collect and test separate samples for each type of grout used on any particular day.

D. Mortar Testing - Test for plastic and hardened properties per ASTM C780. Include the following:

1. Mortar-water content determination (ASTM C780, Annex A4).

2. Mortar-air ratio (ASTM C780, Annex A5).

3. Compressive strength tests (ASTM C780, Annex A6).

E. Grout Compressive Strength Testing

1. Grout compressive strength tests will be performed in accordance with ASTM C1019.

2. One grout sample (three specimens comprise one sample) shall be tested for each grout mix design used on this project.

3.02. EXAMINATION

A. Ensure that field conditions are acceptable and ready to receive work.

B. Beginning of installation means installer accepts existing conditions.

C. New masonry work installed into or adjacent to existing conditions shall match existing construction unless otherwise instructed.

D. Items provided by other sections shall be properly sized and located.

E. Ensure that built-in items are in proper location, and ready for roughing into masonry work.

3.03. PREPARATION

A. Direct and coordinate placement of metal anchors or reinforcing supplied by other sections.

B. Provide bracing of masonry construction. Maintain in place until building structure provides permanent bracing.

3.04. COURSING

A. Match coursing of existing adjacent masonry.

B. Tool mortar joints exposed to view concave.

C. Cut mortar joints flush where below grade, where cavity insulation is to be applied or at other locations concealed from view.

3.05. NEW OPENINGS IN EXISTING MASONRY WALLS

A. Remove existing masonry at opening perimeter as required for all installation of new materials, precast lintels, sills, and jamb blocks.

1. Remove full existing face bricks at jambs of openings so that face brick so that new brick may be toothed in to maintain the running bond patter of the wall.

B. Return facing wythe against back-up wythe closing cavity off at all jamb openings. Install 1/2-inch thick compressible filler and sealant at joint between facing and back-up wythes.

C. Install concrete masonry unit jamb blocks for jambs of all openings. Use half-length and full-length jamb blocks so as to be able to tooth into existing CMU.

3.06. PLACING AND BONDING

A. Lay first course in full bed of mortar.

B. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

C. Lay hollow masonry units with full face shell mortar coverage on head and bed joints.

D. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

E. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Units with broken corners or edges shall not be used in exposed work.

F. Interlock external corners.

G. Unfinished Masonry - Protect at day's end with secured weatherproof covers. Step back for joining new work, no toothing permitted. Remove loose mortar, expose joint, and wet masonry only as required by ACI 530 and ACI 530.1.

H. Replace frozen mortar at Contractor's expense.

3.07. VENTS AND WEEPS

A. Install cavity vents in exterior wythe at 16 inches on center horizontally at top of cavity wall air space.

B. Install cavity weeps in exterior wythe at bottom of cavity wall air space and above flashing; align with vents above.

C. Install cavity weeps above lintels, shelf angles, and other flashing locations.

3.08. CAVITY WALL INSULATION

A. At existing masonry cavity walls undergoing alterations, provide new cavity wall insulation of the greatest possible thickness that will allow a 1-inch airspace between the brick and the insulation.

1. Provide the greatest possible coverage of wall insulation. Trim and fit to provide continuity with existing insulation to remain.

2. Provide thinner or trimmed insulation at lintel conditions to ensure space for mortar drip suspension device and flashing.

3.09. REINFORCEMENT AND ANCHORAGES

A. For infill masonry for existing openings, provide reinforcing bars and dowels in grouted cells as shown by the Typical Plan detail at Existing Masonry Opening Infill detail on Drawing A003 and Horizontal Wall Reinforcement details on Drawing S022.

B. Tie brick veneer to backup concrete masonry or concrete at all locations with specified veneer anchors at a spacing of no greater than 16 inches center-to-center, either vertically or horizontally. At new masonry openings in existing masonry walls, provide veneer anchors immediately adjacent to where face brick returns to meet backup concrete masonry.

3.10. LINTELS

A. For new openings in existing masonry walls, install precast concrete lintels. Install lintels to have 8 inches of bearing on jamb masonry on both sides of openings.

3.11. CUTTING AND FITTING

A. Cut and fit for chases, pipes, conduit, sleeves, and pilasters. Coordinate with other sections of work to provide correct size, shape, and location.

B. Obtain Engineer's approval prior to cutting or fitting masonry work where not indicated, or where appearance or strength of masonry work may be impaired.

3.12. CLEANING

A. Remove excess mortar and mortar smears without degrading mortar bond integrity.

B. Replace defective mortar and masonry units.

C. Clean soiled and effloresced surfaces.

D. Use non-metallic tools in cleaning operations.

E. Without damaging completed work, provide protective boards at exposed external corners and surfaces which may be damaged by construction activities.

END OF SECTION

SECTION 05500

MISCELLANEOUS FABRICATIONS

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Ferrous and non-ferrous metal and fiberglass components, including miscellaneous framing, structural and miscellaneous shapes, plates, anchor rods, bolts and accessories, etc.

B. Shop-fabricated items including bollards, lintels, shelf angles, bearing plates, overhead door frames, wall brackets, custom pipe supports, etc.

C. Manufactured items including ladders, floor access hatches, etc.

1. Access hatch conditions include new hatch in an existing framed opening (reusing existing hatch frame), new hatch and frame in a new opening, and new (hingeless) aluminum cover over a new or existing opening.

1.02. REFERENCES

AAMA	American Architectural Manufacturers Association
ANSI A14.3	Ladders - Fixed - Safety Requirements
ASTM A6	General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A36	Specification for Carbon Structural Steel
ASTM A48	Gray Iron Coatings
ASTM A53	Specification for Pipe, Steel, Black and Hot-Dipped
ASTM A123	Zinc (Hot-Dip Galvanized) Coatings on Steel Products
ASTM A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A276	Specification for Stainless Steel Bars and Shapes
ASTM A307	Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A325	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A489	Carbon Steel Lifting Eyes
ASTM A500	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A536	Ductile Iron Castings
ASTM A572	High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A992	Specification for Structural Steel Shapes
ASTM B209	Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B241	Aluminum-Alloy 6063 Seamless Pipe and Extruded Tube
ASTM B308	Aluminum-Alloy 6061-T6 Standard Structural Profiles
ASTM B632	Aluminum-Alloy Rolled Tread Plate
ASTM D4385	Classifying Visual Defects in Thermosetting Reinforced Plastic Pultruded Products

ASTM E84	Class 7, Fire Retardant Fiberglass Materials
ASTM F593	Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F1554	Anchor Bolts, Steel, 36, 55, and 105 ksi Yield Strength
ASTM F2329	Zinc Coating, Hot-Dip, Requirements for Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
AWS A2.4	Standard Symbols for Welding, Brazing, and Nondestructive Examination
AWS D1.1	Structural Welding Code - Steel
AWS D1.2	Structural Welding Code - Aluminum
AWS D1.3	Structural Welding Code - Sheet Steel
AWS D1.6	Structural Welding Code - Stainless Steel
OSHA 1910.27	Fixed Ladders
SSPC	The Society for Protective Coatings

1.03. SUBMITTALS

A. Shop Drawings

1. Include detailed fabrication drawings with Bill of Materials and finishes, erection drawings, and applicable details such that the Contractor does not need to reference the Contract Drawings.

2. Indicate profiles, sizes, connections, attachments, reinforcing, anchorage, size and type of welds, holes, fasteners, and accessories.

3. Shop drawings shall be submitted in sets of similar fabricated items. Large submittals, generally over 10 sheets, consisting of several different fabricated items will be returned to the Contractor unreviewed.

4. All resubmittals of shop drawings shall have all revisions/corrections clearly highlighted to the Engineer (e.g., labeled, clouded, etc.).

B. Submit manufacturer's product data (i.e., catalog cuts) for floor access hatches, ladders, telescoping safety posts, and other manufactured items that include details of manufactured product with installation instructions.

1.04. COORDINATION

A. Coordinate work with existing field conditions.

B. Field verify all dimensions prior to submittal of shop drawings.

C. Coordinate placement of concrete and grouting of masonry with installation of cast-in (embedded) items.

1.05. QUALIFICATIONS

A. Weld procedures and welder personnel shall be AWS qualified. Keep procedures and certifications on file. Submit only when requested.

PART 2 PRODUCTS

2.01. MATERIALS

A. “W”-Shaped Steel Beams - ASTM A992, Grade 50.

B. “S”-Shaped Steel Beams - ASTM A36 or ASTM A992, Grade 50.

C. “C”-Shaped or “MC”-Shaped Steel Channels - ASTM A36 or ASTM A572 Grade 50.

D. Steel Angles and Plates - ASTM A36.

E. Hollow Structural Sections (HSS)

1. Rectangular and Square Sections - ASTM A500, Grade B, 46 ksi.

2. Round Sections - ASTM A500, Grade B, 42 ksi.

F. Aluminum Sections - ASTM B308, Alloy 6061-T6. Use Aluminum Association shapes.

G. Aluminum Sheet and Plates - ASTM B209, Alloy 5052.

H. Aluminum Checkered Floor Plate - ASTM B632, Alloy 6061-T6.

I. Aluminum Rectangular Bars - ASTM B221, Alloy 6061-75.

J. Stainless Steel Structural Shapes – ASTM A276, Type 316 or Type 316/316L, annealed.

K. Stainless Steel Angles and Plates - ASTM A276, Type 316 or Type 316/316L.

L. Pipe

1. Steel - ASTM A53, Grade B.

2. Aluminum Alloy - 6061-T6.

M. Fiberglass Fabrications - All structural shapes shall be manufactured using the pultrusion process with a minimum glass content of 45 percent. Use extra corrosion-resistant vinyl ester resin material for all shapes and plates. All fiberglass resin shall contain an integral

UV inhibitor and be produced with a resin-rich surface to protect against exposure and wear.

N. Bolts - ASTM F593 stainless steel, Type 316; ASTM A325 carbon steel; galvanized (A325) bolts as a manufactured fastener assembly to comply with ASTM A153 or F2329; ASTM A489 steel lifting eyes.

All bolt accessories including nuts, washers, etc. shall be of the same material as the bolt. Dielectric separation (i.e., neoprene washers) shall be used when a fastener material may be reactive to the base material.

O. Bolted Attachment to Concrete and Masonry – For structural connections, use stainless steel threaded rods with chemical adhesive anchor system as specified in Section 05505, Concrete and Masonry Anchors (expansion anchors are not allowed unless specifically requested by Contractor for a particular application and approved by Engineer).

P. Cast-In Anchor Rods (Bolts) – ASTM F1554 anchor rods galvanized to ASTM A153. Reference Section 05505, Concrete and Masonry Anchors.

Q. Welding Filler Metals and Electrodes - AWS D1.1, D1.2, D1.3, and D1.6.

1. For steel welding, filler metal shall conform to AWS 5.1 or 5.5 and E70xx SMAW electrodes shall be used.

2. Required type(s) for other materials being welded.

R. Touch-Up Primer for Galvanized Surfaces - Zinc-rich paint.

2.02. SHOP-FABRICATED ITEMS

A. Bollards - 4-inch galvanized steel, Schedule 80 pipe; concrete filled (crowned cap); prime and finish paint unless a plastic sleeve is indicated on the Contract Drawings.

B. Steel Shelf Angles (Galvanized)

1. Provide hot-dip galvanized steel lintels as shown on Contract Drawings for support of masonry and veneer.

2. Prime paint galvanized steel angles before installation; exposed surfaces to be finish painted.

C. Steel Lintels (Galvanized)

1. Provide hot-dip galvanized steel lintels as shown on Contract Drawings and where masonry lintels are not indicated for masonry openings larger than 16 inches for concrete block and 8 inches for brick. At doors, windows, HVAC accessories, access panels, and utility penetrations, extend only lintels supporting CMU 8 inches beyond opening (each side).

2. Prime paint galvanized steel lintels before installation; exposed surfaces to be finish painted.

D. Bearing plates with minimum two 5/8-inch diameter by 4 inch long welded studs to be cast in concrete or embedded in grout-filled masonry bond beams.

E. Anchorage for miscellaneous metal items cast in concrete shall have, as a minimum, welded- on strap anchors 2 feet o.c., made from 1/4 inch thick x 1-inch wide x 6-inch long bar stock with each end bent 90 degrees.

F. Pipe Supports

1. Provide pipe supports constructed of structural shapes and materials as detailed on the Contract Drawings.

2. Entire pipe support assembly shall be hot-dip galvanized after fabrication, unless specifically indicated otherwise in the Contract Documents.

2.03. FINISHES

A. Prepare steel surfaces in accordance with SSPC SP 6.

B. Shop prime paint steel items, not galvanized, and top coat after installation. Prime paint shall be compatible with paint (coating) system specified in Section 09900, Painting. Do not prime surfaces where field welding is required.

C. Galvanized items shall be hot-dip galvanized in accordance with ASTM A123 or A153. Provide minimum 2.0 oz/sq. ft. galvanized coating.

D. Unless noted otherwise, aluminum shall be mill finish.

E. Aluminum in contact with concrete or masonry shall be backpainted with bituminous paint.

PART 3 EXECUTION

3.01. EXAMINATION

A. Ensure that field conditions are acceptable and are ready to receive work. Measurements and dimensions to be field verified.

B. Beginning of installation means Contractor has verified and accepts existing conditions.

3.02. FABRICATION

A. Fit and shop assemble in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Welds shall be continuous unless noted otherwise. Grind down welds smooth to remove excess material.

D. Exposed Mechanical Fastenings - Unobtrusively located, consistent with design of component.

E. Supply components required for anchorage of fabrications.

F. Fiberglass Fabrications - All cuts and drilled holes shall be sealed with vinyl ester resin to provide maximum corrosion resistance.

3.03. FABRICATION TOLERANCES

A. Squareness - 1/8-inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces - 1/16-inch.

C. Maximum Misalignment of Adjacent Members - 1/16-inch.

D. Maximum Bow - 1/8-inch in 48 inches.

E. Maximum Deviation From Plane - 1/16-inch in 48 inches.

3.04. INSTALLATION

A. Allow for erection loads and provide sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

B. Install items plumb and level, accurately fitted, free from distortion or defects.

C. Install manufactured items in accordance with manufacturer's instructions.

D. Install and secure all cast-in (embedded) items prior to placement of concrete or grouting of masonry.

E. Perform field welding in accordance with AWS.

F. Fasten aluminum fabrications using Type 316 stainless steel bolts and accessories.

G. Fasten galvanized steel fabrications using A325 galvanized bolts and accessories unless Type 316 stainless steel bolts and accessories are otherwise indicated in the Contract Documents.

H. Fasten fiberglass fabrications using Type 316 stainless steel bolts and accessories.

I. Carbon steel bolts shall only be used for painted carbon steel framing connections.

J. Isolate dissimilar metals with dielectric and use appropriate fasteners.

K. Obtain Engineer approval prior to site cutting or making adjustments not indicated on shop drawings.

L. Prior to installation, aluminum surfaces in contact with concrete and/or masonry require backpainting.

M. After erection, touch up paint welds, bolts, connection material, and abrasions.

N. Top paint all exposed steel that is not galvanized, except for bollards, overhead door frames, shelf angles, and lintels.

O. Touch-up all galvanized surfaces with zinc-rich paint.

P. Fiberglass Fabrications - All field cuts and drilled holes shall be sealed with vinyl ester resin as supplied by the manufacturer to provide maximum corrosion protection.

3.05. INSTALLATION TOLERANCES

A. Maximum Variation From Plumb - ¼-inch.

B. Maximum Offset From True Alignment – ¼-inch.

C. Maximum Out-of-Position – ¼-inch.

END OF SECTION

SECTION 05505

CONCRETE AND MASONRY ANCHORS

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Post-installed chemical adhesive anchor system for installing threaded rods (bolts) and reinforcing bar dowels into concrete and masonry. Both threaded rods (bolts) and dowels are referred to as anchors herein.

B. Limited use of post-installed mechanical anchors in concrete and masonry.

C. Cast-in anchors for attachment to concrete.

D. Embedded anchors for attachment to masonry.

1.02. REFERENCES

ACI 355.1R	State-of-the-Art Report on Anchorage to Concrete
ASTM A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	Carbon Steel Bolts and Studs, 60 ksi Tensile Strength
ASTM A325	Structural Bolts, Heat Treated, 120/105 ksi Tensile Strength
ASTM A449	Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A615	Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM E488	Strength of Anchors in Concrete and Masonry Elements
ASTM E1512	Testing Bond Performance of Bonded Anchors
ASTM F593	Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F594	Stainless Steel Nuts
ASTM F1554	Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ICC AC 308	Acceptance Criteria for Post-installed Adhesive Anchors in Concrete Elements

1.03. SUBMITTALS

A. Submit catalog cuts for chemical adhesive grout product to be used for anchoring threaded rods (bolts) and dowels into concrete and/or masonry. Catalog cuts (do not submit whole catalogs) shall be clearly marked to include:

1. Tension and shear strength design values for each anchor size used on this project.

2. Manufacturer’s installation instructions.

3. Allowable temperature range for proper anchor installation.

B. Submit the ICC-ES Evaluation Service Report (ESR) for proposed adhesive anchor system if not a named product below in Part 2.

C. Submit data on adhesive anchor threaded rods to be used, including materials, sizes, lengths, etc.

D. Submit catalog cuts on mechanical, expansion-type anchor bolts and drop-ins, and clarification on the requested use.

1.04. QUALITY ASSURANCE

A. If the Contractor is not experienced in installing chemical adhesive anchors, or as requested by the Engineer, a representative from the adhesive anchor manufacturer shall be present at start of project to instruct the Contractor on how to properly install the adhesive anchors.

B. Upon request, 5 percent of all adhesive anchors shall be proof-loaded by an independent testing laboratory. The location(s) shall be determined by Engineer. These tests shall be paid for by the Contractor and the results shall be submitted to the Engineer.

C. Adhesive anchor systems shall have a current ICC-ES Evaluation Service Report that states recommended design capacities. Reports shall be performed in accordance with ICC AC308 and ASTM E1512.

1.05. COORDINATION

A. Coordinate the placement of anchor bolts with approved items and fabrications.

PART 2 PRODUCTS

2.01. MATERIALS

A. Adhesive anchor system shall be a high-strength, premeasured, two-part, self-mixing, cartridge-type epoxy adhesive such as “HIT HY 200” by Hilti, Inc.; “Epcon S7” by ITW Red Head, “Set-XP” by Simpson Strong-Tie Company, Inc.; or equal.

1. Provided adhesive anchor system shall meet or exceed the minimum loading capacities of these specified products.

2. Where anchors or dowels are to be drilled and embedded into hollow (ungrouted) masonry, provide adhesive and sleeve (screen tube) system for this specific application.

B. Mechanical Anchors – Mechanical (expansion-type) anchors are not allowed unless specifically requested (for a special application) by the Contractor and approved by Engineer in writing. Refer to limitations of use stated in Part 3.

1. If approved, they shall be hot-dip galvanized or stainless steel expansion-type bolts or drop-in anchors.

2. Anchors shall be rated for a minimum of twice the required load capacity.

C. Cast-in Anchor Rods (Bolts) – ASTM F1554 anchor rods galvanized to ASTM A153. Use minimum 3/4-inch diameter headed rods (with welded nut) 18 inches long, or as shown on the Contract Drawings.

D. Stainless Steel Threaded Rods – ASTM A593, Type 316.

E. Stainless Steel Nuts – ASTM A594, Type 316.

F. Reinforcing Steel Dowels – ASTM A615, Grade 60 deformed bar.

G. All threaded rods and anchor bolt accessories, including nuts, washers, etc. shall be of the same material as the rods/bolts.

PART 3 EXECUTION

3.01. INSTALLATION OF ADHESIVE ANCHOR SYSTEMS

A. All bolted connections to concrete and masonry shall utilize an adhesive anchor system as specified above.

B. Threaded stainless steel rods shall be used for all anchor bolt applications, unless noted otherwise in the Contract Documents.

C. Provide templates or other means to accurately locate anchors.

D. Drilled holes shall be cleaned out and shall be free of dust and trapped water.

E. Masonry wall (cores) shall be filled with grout where anchors are to be installed. In existing construction where masonry cores are not (and cannot be) grout filled, manufacturer's masonry screen tube shall be used with anchor installation.

F. Install adhesive anchors in accordance with manufacturer's recommendations.

G. Anchor bolts installed into concrete and/or masonry shall not be closer than 6 inches o.c. unless indicated otherwise.

H. All structural members bolted to concrete and/or masonry shall be made with a minimum of two 5/8-inch diameter anchors at each connection.

I. Anchor bolts and dowels shall be clean and free of coatings or other contaminants that would impair bonding to the chemical adhesive.

J. Threaded rods shall be long enough to project through the entire depth of nut and shall be cut off at 1/2 inch beyond the top of nut.

K. Anchor bolts and dowels shall not be installed in concrete less than seven days old, or older if recommended by the manufacturer.

L. Adhesive anchors shall be fully cured prior to applying load on anchor.

3.02. INSTALLATION OF CAST-IN AND EMBEDDED ANCHORS

A. All cast-in and embedded anchors shall be hot-dip galvanized unless noted otherwise in the Contract Documents.

B. Provide templates or other means to accurately place anchors.

C. Anchors shall be secured in place to not allow displacement during placement of concrete or masonry grout.

D. Concrete or masonry grout shall be thoroughly vibrated around the anchors for proper bonding of the anchors.

E. Anchor rods shall be long enough to project through the entire depth of nut and shall be cut off at 1/2 inch beyond the top of nut.

F. Concrete or masonry shall be at full 28-day compressive strength prior to applying load on anchor.

3.03. INSTALLATION OF MECHANICAL ANCHORS

A. Mechanical (expansion-type) anchors are only allowed for overhead (ceiling) applications where thru-bolting cannot be performed. Mechanical anchors are not allowed for any other use unless specifically requested (for a special application) by the Contractor and approved by Engineer in writing.

B. Mechanical anchors shall support static tension loads not exceeding 200 lbs. per anchor.

C. Drilled holes shall be cleaned out and free of dust.

D. Anchors shall be fully seated prior to pretension. Pretension in accordance with manufacturer's instructions.

E. Engineer may request any/all these mechanical anchors to be proof-loaded.

END OF SECTION

SECTION 05510

METAL STAIRS

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Framing for metal stairs, use structural shapes.

B. Tread types for metal stairs are open grate or made using specialty manufactured extruded planks as indicated herein.

C. Closed risers using bent plate made of the same material as the stair treads.

D. Landings that are part of the stair system, use the same material to match tread design.

1.02. DESIGN REQUIREMENTS

A. Fabricate stairs and landings to support a live load of 100 lb/sq.ft. and a concentrated load of 300 lbs., with deflection of stringers or landing framing not to exceed 1/360 of span.

B. Provide stair treads and landing surfaces per Section 05531, Grating and Floor Plank.

C. Fabricate stair railings per Section 05520, Railing Systems.

1.03. SUBMITTALS

A. Delegated Design - Engage a qualified professional engineer to design stairs, railings, and guards, including attachment to building construction.

B. Shop Drawings - Include complete set of calculations, fabrication details and erection plans, including connections, attachments, reinforcing, anchorage, size and type of fasteners, accessories, and all dimensions. The shop drawing to be stamped and signed by a New York State professional engineer. Photocopies of Contract Drawings, in whole or in part, are not acceptable.

C. Indicate welded connections using standard AWS welding symbols.

D. Submit product data for manufactured items, with items of intended use highlighted or otherwise indicated.

E. Stair treads and landing surfaces shall be submitted under Section 05531, Grating and Floor Plank, and must be approved prior to approval of stair shop drawings.

1.04. COORDINATION

A. Field verify all measurements and elevations prior to submittal of shop drawings.

B. Obtain approval on stair treads from Engineer prior to submitting stair shop drawings.

PART 2 PRODUCTS

2.01. MATERIALS

A. For stair (and landing) framing, reference Section 05500, Miscellaneous Fabrications.

1. Fabricate stair stringers and landing frames that are a continuation of the stair stringers using channels as indicated on the Contract Drawings.

2. Fabricate tread and landing surface supports with angles or channels as indicated on the Contract Drawings.

B. For stair treads and landing surfaces, reference Section 05531, Grating and Floor Plank.

1. Use grated stair treads and landing surfaces for exterior stairs unless indicated otherwise on the Contract Drawings.

2. Use solid surface plank stair treads and extruded planks at landing surfaces for interior stairs unless indicated otherwise on the Contract Drawings.

C. Solid risers are custom fabricated using bent metal plate attached to the treads as indicated on Contract Drawings.

D. For guardrails and handrails (railings), reference Section 05520, Railing Systems.

E. Fasteners for aluminum fabrications shall be Type 316 stainless steel.

2.02. FABRICATION

A. Reference Section 05500, Miscellaneous Fabrications, for standard fabrication requirements.

B. Fit and shop assemble in largest practical sections, for delivery to site.

C. Fabricate components with joints tightly fitted and secured.

D. Seal jointed metal pieces by continuous welds.

E. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

F. Supply components required for anchorage of fabrications. Use Type 316 stainless steel connectors on aluminum.

G. Clean, straight, sharply-defined profiles with smooth surfaces of uniform color, free from defects. Where possible, weld on unexposed side in order to prevent pitting or discoloration. Finish to be free from scratches, “leave-off marks,” or other surface blemishes.

H. Provide all hangers, framing clips, anchors, etc., required for complete installation.

2.03. FINISHES

A. Aluminum surfaces to be mill finish.

B. Backpaint aluminum surfaces to be in contact with concrete or masonry with bituminous paint.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work. Measurements and dimensions to be field verified.

B. Beginning of installation means Contractor has verified and accepts existing conditions.

3.02. PREPARATION

A. Supply items required to be cast into concrete or embedded in masonry.

3.03. INSTALLATION

A. Install items as detailed on approved shop drawings and in accordance with specified requirements. All components shall be installed plumb and level, accurately fitted and rigid, free from distortion or defects.

B. Provide anchors, plates, angles, hangers, and struts required for connecting stairs to structure.

C. All bolts and anchors to concrete or masonry shall be stainless steel, adhesive type per Section 05505, Concrete and Masonry Anchors.

D. Allow for erection loads and provide sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

E. Wherever possible, weld rather than bolt. Field weld components indicated on approved shop drawings.

Perform welding in accordance with AWS Standard. Grind welds smooth and flush.

F. Field bolt to match shop bolting. Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings, as applicable.

Bolt threads shall not project beyond nuts more than one thread or shall be cut off and ground smooth. Nuts shall have the thread upset to prevent nut from loosening after erection.

G. Exposed work shall be neatly finished. Joints shall be made true and tight. Mechanically fasten joints butted tight.

H. Obtain Engineer approval prior to site cutting or making adjustments not indicated on approved shop drawings.

3.04. INSTALLATION TOLERANCES

A. Maximum Variation From Plumb - 1/4-inch.

B. Maximum Offset From True Alignment - 1/4-inch.

C. Maximum Variation of Riser Height - 3/8 inch (in any flight of stairs).

D. Maximum Variation of Tread Depth - 3/8 inch (in any flight of stairs).

END OF SECTION

SECTION 05520

RAILING SYSTEMS

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Aluminum guardrails and handrails (both referred to as railing).

B. Aluminum railings to be assembled using non-welded components with internal splice insert system that produces a consistent outside diameter/dimension of fittings and railing.

C. Aluminum toeboards to be installed on guardrails where toeboard has been removed or is not installed.

1.02. REFERENCES

A. AAMA - American Architectural Manufacturers Association

B. ASTM B221 - Aluminum Alloy 6063 Extruded Bars, Rods, Wire, Shapes, and Tubes

C. ASTM B241 - Aluminum Alloy 6063 Seamless Pipe and Extruded Tube

1.03. DESIGN REQUIREMENTS

A. Railing assembly, wall rails, and attachments to resist the maximum force from a concentrated lateral load of 200 lbs. or a uniform load of 50 lbs. per linear foot at any point or direction without damage or permanent set. Vertical posts must withstand concentrated load applied at the top of 200 lbs. (with a 4-foot maximum aluminum post spacing).

1.04. DELIVERY, STORAGE AND HANDLING

A. Protect from corrosion, deformation and other types of damage. Store items in an enclosed area free from contact with soil and weather. Replace damaged items with new materials.

1.05. SUBMITTALS

A. Shop Drawings - Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, accessories, materials, and finishes.

B. Provide detailed shop fabrication and erection drawings to include connections, fittings, complete bill of materials, finishes, etc.

C. Product Data - Provide single-page catalog cut sheets on base mounts, side mounts, wall brackets, internal splice connectors, and all manufactured items.

1.06. COORDINATION

A. Field verify all dimensions before fabrication.

PART 2 PRODUCTS

2.01. MANUFACTURERS

A. Aluminum Products

1. Julius Blum and Company - Connectorail system with #7571 floor flange or #757/758 facia flange (aluminum).

2. Moultrie Mfg. Company - Wesrail II system with #W32612 base or #WIISMBEXT side-mount bracket (aluminum).

3. Tubular Specialties Mfr., Inc. - AdaptaRail system with #662 floor flange (aluminum).

4. Or equal. (Substitutes are allowed provided that the submitted manufacturer can demonstrate satisfaction of load requirements as stated above.)

2.02. ALUMINUM RAILING SYSTEM

A. Rails - 1-1/2-inch nominal diameter, extruded aluminum pipe per ASTM B241.

1. Use Schedule 40 pipe for interior applications.

2. Use Schedule 80 pipe for exterior applications.

B. Posts - 1-1/2-inch nominal diameter, extruded aluminum Schedule 80 per ASTM B241.

C. Fittings - Elbows, T shapes, wall brackets, escutcheons, etc.; machined aluminum.

D. Welded components require aluminum filler Alloy 5356 to improve color match after anodizing treatment.

E. Mounting - Pre-manufactured, heavy duty, four-bolt floor flange (with internal reinforcement post) or four-bolt side-mount fixture.

F. Splice Connectors - Concealed spigot machined aluminum.

G. Exposed Fasteners - Flush countersunk stainless steel screws or bolts; consistent with design of railing.

H. Vertical posts to be spaced at 4 feet o.c. maximum.

I. Toeboards shall be manufacturer’s standard aluminum shape, OSHA compliant.

2.03. FABRICATION

A. Fabricate aluminum railing with compatible connectors, fittings and fasteners. Joints to be mechanical without welding.

B. Provide floor mounts and/or side mounts, wall brackets, terminals, flanges and caps, etc., as indicated and required for complete installation. Details of railing systems to be as indicated on Contract Drawings.

C. Fit and shop assemble components in largest practical sizes, for delivery to site.

1. Fabricate components with joints tightly fitted and secured.

2. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Supply components required for anchorage of fabrications. Fabricate related components of same material and finish as fabrication.

E. Accurately form components to suit stairs, landings, and building structure. Terminate stair handrails as indicated on Contract Drawings.

F. All exterior railings shall be protected from entrapped water and from temperature-induced stresses. The railing manufacturer shall provide weep holes and expansion joints.

G. Toeboards shall be provided at all railings, except at top of curbs and walls (extended more than 4 inches above walking surfaces) and where the platform or walkway framing extends a minimum of 4 inches above the walking surface. Toeboards shall be fastened at each post. Provide expansion joints at 20-foot maximum intervals with 1/4-inch opening.

H. Aluminum toeboards to be installed on guardrails where toeboard has been removed or is not installed.

2.04. FINISHES

A. Aluminum railing systems shall receive a clear anodized finish meeting AAMA, Class I.

B. Aluminum toeboards shall be mill finish.

C. Backpaint aluminum surfaces in contact with concrete or masonry with bituminous paint.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

B. Beginning of installation means Contractor has verified and accepts existing conditions.

3.02. PREPARATION

A. Supply items required to be cast into concrete or embedded in masonry.

3.03. DISSIMILAR MATERIALS

A. Make connections using stainless steel fasteners and isolate with dielectric as needed.

B. Aluminum to be in contact with concrete or masonry shall be backpainted with bituminous paint.

3.04. INSTALLATION

A. Install railings in accordance with approved shop drawings. Manufactured components shall be installed in accordance with manufacturer's instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects.

C. All anchoring and attachments to concrete or masonry shall use chemical adhesive anchors.

D. Provide and install anchors, plates or angles required for connecting railings to structure.

E. Conceal bolts and screws whenever possible.

3.05. INSTALLATION TOLERANCES

A. Maximum Variation From Plumb - 1/4-inch.

B. Maximum Offset From True Alignment - 1/4-inch.

END OF SECTION

SECTION 05531

GRATING AND FLOOR PLANK

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Aluminum stair treads.

1.02. REFERENCES

A. AWS A2.4 - Standard Symbols for Welding

B. AWS D1.2 - Welding Code - Aluminum

C. NAAMM MBG 531 - Metal Bar Grating Manual

D. NAAMM MBG 533 - Welding Specifications for Fabrication of Steel, Aluminum, and Stainless Steel Bar Grating

E. ASTM B221 - Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

F. ASTM B308 - Aluminum Alloy 6061-T6 Standard Structural Shapes

1.03. PERFORMANCE REQUIREMENTS

A. On Drawings where depth of grating or plank is not indicated or where no loading requirements are specified, the grating or plank shall be designed for the following:

1. At Platforms and Walkways - Uniform live load of 60 lbs/sq. ft. and a concentrated load of 300 lbs.

2. At Stairs and Stair Landings - Uniform live load of 100 lb/sq. ft. and a concentrated load of 300 lbs.

B. Maximum Allowable Deflection Under Live Load

1. Aluminum Grating - 1/240 of span.

C. Clear space between grating bearing bars shall be 1 inch or less.

1.04. SUBMITTALS

A. Shop Drawings

1. Indicate details of gratings, stair treads, extruded planks, aluminum plank covers, component supports, fasteners, openings, perimeter construction details, and tolerances.

2. Provide detailed fabrication and erection drawings showing panel layouts indicating all panel sizes and weights.

B. Provide catalog cut of selected grating details along with manufacturer's span and deflection tables.

1.05. QUALIFICATIONS

A. Weld procedures and welder personnel must be AWS qualified. Maintain procedures and certificates on file.

1.06. COORDINATION

A. Field verify all dimensions prior to fabrication.

B. Coordinate placement of panels with platform/walkway framing.

PART 2 PRODUCTS

2.01. MANUFACTURERS

A. Aluminum Grating

1. IKG Industries - Product: Aluminum 3/16-inch wide rectangular bar, Type BS (P-19-4) with serrated surface. IKG Industries extruded frame.

2. Ohio Gratings, Inc. - Product: Aluminum 3/16-inch wide rectangular bar Type 19-SG-4 with serrated surface. Ohio Gratings extruded angle frame.

3. Or equal.

B. Grated Stair Treads - Use same type, finish, and bar spacing as floor grating. Provide with cast aluminum abrasive (non-slip) nosing on aluminum treads. Use manufacturer's standard non-slip nosing on fiberglass treads.

2.02. MATERIALS

A. Aluminum Grating, Stair Treads, Frames, Support Angles, and Banding - ASTM B221 alloy 6061 T6 or 6063 T6; mill finish. Stair treads to have abrasive (non-slip) nosings.

2.03. DISSIMILAR MATERIALS

A. Where dissimilar metals contact, provide approved dielectric of laminated plastic.

B. Backpaint aluminum support frames and angles in contact with concrete or masonry using a bituminous paint.

2.04. ACCESSORIES

A. Fasteners - All fasteners, including hold-down clips, to be Type 316 stainless steel for fiberglass grating and for aluminum grating.

2.05. FABRICATION

A. Aluminum plate covers (panels) to be fabricated as above specified extruded aluminum plank panels with custom lift handles at each end (reference details on the Contract Drawings).

PART 3 EXECUTION

3.01. EXAMINATION

A. Ensure that opening sizes and dimensional tolerances are acceptable.

B. Ensure that supports, anchors, edge bands and frames are correctly positioned.

3.02. INSTALLATION

A. Items to be installed in conformance with specifications and details shown on approved shop drawings with all parts in alignment, true and rigid.

B. Install components in accordance with manufacturer's instructions.

C. Mechanically cut aluminum components.

D. All grating bearing bars shall be banded and completely supported and not allowed to deflect by hanging off cross bars.

E. Brackets, supports, and other details not shown on the Contract Drawings, but necessary for the work, shall be furnished by the Contractor.

3.03. INSTALLATION TOLERANCES

A. Conform to NAAMM MBG 531 and FGM-2003 where applicable and as indicated below.

1. Maximum Space Between Adjacent Sections - 1/8 inch.

2. Maximum Variation From Top Surface Plane of Adjacent Sections - $\pm$1/8 inch.

END OF SECTION

SECTION 06112

FRAMING AND SHEATHING

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Structural and non-structural framing and dimension lumber.

B. Miscellaneous roof framing.

C. Sill gaskets.

D. Preservative treatment of wood.

1.02. REFERENCES

A. ALSC American Lumber Standards Committee: Softwood Lumber Standards.

B. APA - American Plywood Association.

C. AWPA (American-Wood Preservers' Association) U1 - Use Category System.

D. AWPA - Standards Used for Quality Control of Micronized Copper Quaternary Treatments: Analytical Standards A2-06, A3-05, A9-01, A11-93, A17-03, A18-05, A21-00, A36-04, A37-05.

E. ICC Evaluation Services, Inc. - ICC-ES Report and ESP 1980.

F. NeLMA - Northeastern Lumber Manufacturers Association.

G. NPA - National Particleboard Association.

H. PIB - Southern Pine Inspection Bureau.

1.03. SUBMITTALS

A. Submit under provisions of Section 01300, Submittals.

B. Provide product data, including dimensions, configuration, base and finish materials, and performance characteristics for items listed below. Include installation or use instructions where applicable.

1. Wood preservative materials.

2. FRP-faced plywood.

3. Sill gaskets.

C. Evaluation Report (MCQ) - ICC Evaluation Services, Inc., ESP-1980.

1.04. QUALITY ASSURANCE

A. Perform Work in accordance with the following agencies:

1. Lumber Grading Agency - Certified by ALSC.

2. Plywood Grading Agency - Certified by APA.

3. Preservative-Treated Lumber and Plywood - Certified by AWPA.

B. In lieu of grade stamping exposed-to-view lumber and plywood, submit manufacturer's certificate that products meet or exceed specified requirements.

C. Obtain treated wood products from a single source.

1.05. DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site.

B. Protect site framing lumber from warping or other distortion by stacking horizontally, allowing air circulation. Position with spacers to allow ventilation.

C. Do not store products in building until wet trade materials are dry.

1.06. SIZES AND SURFACING

A. PS 20 for dressed sizes of yard and structural lumber, surfaced four sides. Size references are nominal sizes; actual sizes shall be within manufacturing tolerances of standard under which product is produced.

1.07. MOISTURE CONTENT

A. Moisture content at delivery.

1. Framing Lumber 2 Inches and Less in Thickness - 19 percent maximum.

2. Boards - 19 percent maximum.

3. Framing Lumber Over 2 Inches Thick - 25 percent maximum.

4. Materials Other Than Lumber - Moisture content shall be in accordance with standard under which product is produced.

PART 2 PRODUCTS

2.01. LUMBER PRODUCTS

A. Sawn Lumber

1. Lumber Grading Rules – NeLMA Standard Grading Rules for Northeastern Lumber, and SPIB Standard Grading Rules for Southern Pine.

2. Structural Light Framing - Mixed Southern Pine No. 2; minimum Fb for single use up to 12-inch wide: 875 psi; E = 1,400,000 psi; 19 percent maximum moisture content.

3. Non-Structural Light Framing – Spruce-Pine-Fir South No. 2; minimum Fb for single use up to 12-inch wide: 750 psi; E = 1,100,000 psi; 19 percent maximum moisture content.

4. Studding - Spruce-Pine-Fir South No. 2; minimum Fb for single use up to 6-inch wide: 975 psi; E = 1,100,000; 19 percent maximum moisture content.

5. Blocking and Miscellaneous Framing - Spruce-Pine-Fir South No. 2; minimum Fb for single use up to 12-inch wide: 750 psi; E = 1,100,000 psi; 19 percent maximum moisture content.

6. Preservative-Treated Lumber – Southern Pine No. 2; minimum Fb for single use up to 6-inch wide: 1,250 psi; E = 1,600,000 psi; 19 percent maximum moisture content.

7. Finger-jointed lumber may be used in the same applications as solid lumber of an equivalent species and grade, provided the finger jointed lumber meets all the requirements of the certification and the quality control programs of the rules writing agency having jurisdiction and all applicable requirements of SP 56.

2.02. SHEATHING MATERIALS

A. Plywood Roof Sheathing – Tongue and groove 23/32-inch Sturd-I-Floor APA Rated Sheathing Structural I, span rating 24OC; Exposure 1.

B. FRP-Faced Plywood

1. Applied to wood furring where shown on Room Finish Schedule.

2. 5/8-inch thick C-C plugged exterior plywood with a minimum 0.09-inch thick FRP facing layer. Gel-coated and embossed facing layer to have a Class A flame spread rating. Basis of design: Kemlite Fire-X Glasbord with Surfaseal or equal.

2.03. ACCESSORIES AND ROUGH HARDWARE

A. Fasteners and Anchors

1. Fasteners - Stainless steel for securing wood treated with CBA and ACQ formulations, coated or galvanized steel for securing wood treated with MCQ formulations, and unfinished steel elsewhere.

2. Rough hardware shall be the type and size necessary for project requirements. Sizes, types, and spacing of fastenings of manufactured building materials to be as recommended by product manufacturer. Rough hardware exposed to the weather, embedded in or in contact with exterior masonry, concrete walls, or slabs shall be stainless steel. Nails and fastenings for fire retardant treated lumber and woodwork exposed to the weather shall be copper alloy.

B. Gasket Under Truss Bearing on Top of Masonry Wall - 1/4 inch thick, wall width, closed cell polyethylene foam from continuous rolls.

C. Metal Framing Anchors - Construct anchors to the configuration shown using hot dip zinc coated steel conforming to ASTM A525, coating designation G90. Except where otherwise shown, steel shall not be lighter than 18 gauge. Special nails supplied by the manufacturer shall be used for all nailing.

2.04. PRESERVATIVE TREATMENT

A. Pressure Treatment

1. Preservative treatment chemical shall be:

a. Wolman E as manufactured by Arch Wood Protection, Inc., of Smyrna, GA.

b. ACQ as manufactured by Chemical Specialties, Inc, of Charlotte, NC.

c. Micronized Copper and Quaternary (MCQ) Treatment, “Micropro” by Osmose, Inc., of Griffin, GA.

d. Or equal as approved by Engineer.

2. Preservative treatment shall not contain arsenic or chromium.

3. Retention of preservative chemical shall be as follows:

a. For CBA or ACQ formulations, retention shall be as required to meet AWPA Standard U1 for the appropriate Use Category as defined therein, but in no case shall retention be less than 0.20 pounds per cubic foot for CBA formulations or 0.25 for ACQ formulations.

b. For MCQ formulations, retention shall meet accepted standards from ICC Evaluation Services, Inc., ESP 1980.

4. Lumber shall be kiln-dried after preservative treatment.

B. Cuts made in lumber after treatment shall be coated according to the recommendations of the preservative treatment manufacturer.

C. All lumber to be installed in contact with concrete or masonry; or to be used to frame or block roof openings or penetrations; or to be installed as sub-facia boards, shall be pressure treated with preservative. This includes wood plates secured to the tops of masonry walls.

PART 3 EXECUTION

3.01. INSTALLATION – GENERAL

A. Closely fit rough carpentry, set accurately to required lines and levels, and secure in place in rigid and substantial manner. Do not splice framing members between bearing points. Set joists, rafters, and purlins with their crown edge up. Frame members for the passage of pipes, conduits, and ducts. Do not cut or bore structural members for the passage of ducts or pipes without Engineer's approval. Reinforce all members damaged by such cutting or boring by means of specially formed and approved sheet metal or bar steel shapes, or remove and provide new, as approved. Provide as necessary for proper completion of work all framing members not indicated or specified. Spikes, nails, and bolts shall be drawn up tight. Timber connections and fastenings shall conform to NFPA National Design Specification for Wood Construction.

B. Set structural members level and plumb, in correct position.

C. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing.

D. Place horizontal members flat, crown side up.

E. Construct load bearing framing members' full length without splices.

F. Lumber in contact with concrete or masonry shall be preservative treated by treatment with an approved preservative treatment system per paragraph 2.04.A.

G. Tolerances

1. Framing Members - 1/4 inch from true position, maximum.

3.02. MISCELLANEOUS

A. Wood Blocking - Provide proper sizes and shapes at proper locations for the installation and attachment of wood and other finish materials, fixtures, equipment, and items indicated or specified.

B. Wood Furring - Provide where shown and as necessary for facing materials specified. Except as shown otherwise, furring strips shall be 1-inch by 3-inch, continuous, and spaced 24 inches on centers each way. Erect furring as shown on Drawings. Nail furring strips to truss bottom chord. Provide furring strips around openings, behind bases, and at angles and corners. Furring shall be plumb, rigid, and level and shall be shimmed as necessary to provide a true, even plane with surfaces suitable to receive the finish required.

C. Temporary Closures - Provide with hinged doors and padlocks and install during construction at exterior doorways and other ground level openings that are not otherwise closed. Cover windows and other unprotected openings with polyethylene or other approved material, stretched on wood frames. Provide dustproof barrier partitions to isolate areas as directed.

D. Temporary Centering, Bracing, and Shoring - Provide for the support and protection of masonry work during construction as specified in Section 04300. Forms and centering for cast in place concrete work are specified in Section 03300.

3.03. APPLICATION

A. Cutting of wood members that becomes necessary for the installation of mechanical equipment, such as ductwork, fans, piping, electrical equipment, etc., is the responsibility of the Contractor. Fit woodwork around equipment, etc., as required.

B. Joints shall be fitted tightly to avoid opening later. Keep work plumb, true and in place, free from stains and tool marks. All pieces shall be as long as possible and splices shall be made carefully. Blind nail when possible.

END OF SECTION

SECTION 07190

VAPOR AND AIR BARRIERS

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Furnish and install vapor retarders, air barriers, and required accessories in accordance with the Contract Documents including, but not limited to, the following:

1. Air and Vapor Barrier – Fluid-applied elastomeric air and vapor barrier for installation to the exterior of concrete masonry unit walls; designated “AVB” on Drawings.

    a. System includes all detail tapes, flashings, sealants, control joint treatment and adhesives required to provide:

2. Continuity of the air and vapor barrier across the masonry surface and connections to adjacent construction.

3. Weather protection including positive drainage from the masonry wall cavity.

    a. AVB, in conjunction with insulation, and veneer masonry, must comply with the regulatory requirements stated in Article 1.05 of this section.

4. Cold-Applied, Single-Component Waterproofing – For exterior insulated slabs with heated spaces below

5. Cold-Applied, Single-Component Waterproofing – For exterior below-grade foundation walls.

1.02. REFERENCES

A. Sealant, Waterproofing, and Restoration Institute (SWRI) – Sealants: The Professionals Guide.

B. ASTM D882 – Tensile Properties of Thin Plastic Sheeting

C. ASTM D4833 – Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products

D. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials

E. ASTM E96 – Standard Test Method for Water Vapor Transmission of Materials

F. ASTM E1643 – Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs

G. ASTM E1745 – Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs

H. ASTM E2357 – Standard Test Method for Determining Air Leakage of Air Barrier Assemblies

I. ICC Evaluation Service (ICC-ES) – Evaluation Reports

J. NFPA 259 – Standard Test Method for Potential Heat of Building Materials

K. NFPA 285 – Standard Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components

1.03. PERFORMANCE REQUIREMENTS

A. Materials of this section shall provide continuity of the building enclosure vapor or air barrier as indicated in the Contract Documents.

B. Where foam plastic insulation forms part of an exterior wall assembly, such assembly must comply with the regulatory requirements stated in Article 1.05.

1.04. REGULATORY REQUIREMENTS

A. Completed exterior wall assemblies, including insulation, vapor barrier, air barrier, weather barrier, flashing, sealants, and adhesives are to match that of an assembly that has been tested and met the requirements of NFPA 285, or match that of an assembly described in an ICC-ES Evaluation Report that certifies the assembly as meeting IBC Section 2603.5

1.05. SUBMITTALS

A. Provide in accordance with Section 01300, Submittals, and as supplemented herein. Submittals shall include, but not be limited to, the following:

B. Product Data

1. For all sheet and fluid-applied materials, provide manufacturer's technical literature indicating composition, tensile strength, permeability, and other relevant characteristics.

2. For all vapor retarder, vapor barrier or air barrier materials, provide manufacturer's technical literature describing all accessory materials required for a complete installation including, but not limited to, flashings, detail membranes or tapes, edge sealants, and adhesives.

3. Provide detailed installation instructions indicating conditions necessary for fluid-applied membranes and associated accessories to function as an effective barrier system, integrated with the wall, window and door configurations specific to this project.

4. Submit a letter from the manufacturer of compliance with regulatory requirements.

C. Submit manufacturer's samples of sheet products.

D. Shop Drawings - Provide standard details, special details, and assistance to Contractor for use by suppliers of products referenced in sections listed in Article 1.02 in preparing detailed coordination drawings.

E. Where foam plastic insulation forms part of an exterior wall assembly: submit proof of compliance with the regulatory requirements of Article 1.05.

1.06. QUALITY ASSURANCE

A. Where relevant, perform work in accordance with SWRI Sealant and Caulking Guide Specification requirements for materials and installation

1.07. DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the site in manufacturer's original, unopened containers with labels clearly identifying product name and manufacturer.

B. Store materials in a clean dry area in accordance with manufacturer's instructions.

1.10. ENVIRONMENTAL REQUIREMENTS

A. Maintain temperature and humidity recommended by the materials manufacturers before, during, and after installation.

1.11. SEQUENCING

A. Sequence work to permit installation of materials in conjunction with other materials and seals.

1.12. COORDINATION

A. Coordinate the work of this section with all sections referencing this section or referenced by this section.

PART 2 PRODUCTS

2.01. SYSTEMS

A. Air and Vapor Barrier (AVB) – Fluid-applied elastomeric air and vapor barrier for installation to the exterior of concrete masonry unit walls and to the top surface of precast concrete ceiling planks, designated "AVB" on Drawings. To include all accessories and components of a complete system by a single manufacturer, or with all components approved in writing by the membrane manufacturer and a letter from the manufacturer of compliance with regulatory requirements.

1. Performance

a. Volatile organic compounds less than 52 µg/L.

b. Water Vapor Permeance per ASTM E96.B less than one Perm.

c. Air Leakage 0.0075 CFM/ft2 or less per ASTM E2357.

d. Flame Spread Index less than 25, and Smoke Generation 200 or less per ASTM E84.

2. Manufacturers

a. Carlisle Coating & Waterproofing, Inc.

b. W. R. Meadows Inc.

c. Tremco Commercial Sealants & Waterproofing, Inc.

B. Cold –Applied, Single-Component Waterproofing - For exterior insulated slabs with heated spaces below. To meet or exceed the requirements of ASTM C836. To include all accessories and components of a complete system by a single manufacturer, or with all components approved in writing by the manufacturer.

1. Hydralastic 836 - W. R. Meadows Company

2. Henry CM100 – Henry Company

3. ConSeal CS-1800 Waterproofing Membrane – Concrete Sealants Inc.

C. Cold –Applied, Single-Component Waterproofing - For exterior below grade foundation walls. To meet or exceed the requirements of ASTM C836. To include all accessories and components of a complete system by a single manufacturer, or with all components approved in writing by the manufacturer.

1. Hydralastic 836 - W. R. Meadows Company

2. Henry CM100 – Henry Company

3. ConSeal CS-1800 Waterproofing Membrane – Concrete Sealants Inc.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify that surfaces and conditions are ready to accept the work.

3.02. PREPARATION

A. Remove objects which might impale/puncture sheet material.

B. Remove loose or foreign material which might impair adhesion of seam and flashing tapes

C. Prime surfaces where directed by manufacturer’s instructions

3.03. INSTALLATION OF SHEET MATERIALS

A. Install sheet materials in accordance with manufacturer’s instructions; tape all seams

B. Lap sheet materials and seal with tape. Position lap seal over firm bearing.

C. Cut sheet materials tight to pipes and other slab penetrations. Seal to penetrating objects with tape. At pipe penetrations, seal with prefabricated pipe boots

D. Repair holes or punctures with self-adhesive tape.

3.04. INSTALLATION OF FLUID-APPLIED SYSTEMS

A. Install fluid-applied systems in accordance with manufacturer’s instructions.

B. Use self-adhesive flashing or detail material, in combination with compatible sealants and adhesives, to provide continuity between barrier membrane and window, door and louver frames.

C. Connect barrier membrane to flashings to provide continuous weather protection and positive drainage in wall assemblies.

D. Provide flexible and air-tight connections between membrane surfaces on either side of substrate movement joints.

3.05. PROTECTION OF FINISHED WORK

A. Do not permit adjacent or subsequent work to damage work of this section.

END OF SECTION

SECTION 07212

BOARD INSULATION

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Board insulation installed in unit masonry system cavity walls.

1.02. REFERENCES

ASTM D1187	Standard Specification for Asphalt Base Emulsions for Use as Protective Coatings for Metal
ASTM D1227	Standard Specifications for Emulsified Asphalt Used as a Protective Coating for Roofing
ASTM C578	Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation

1.03. PERFORMANCE REQUIREMENTS

A. Materials of this section shall provide continuity of thermal barrier at building enclosure elements.

1.04. SUBMITTALS

A. Submit under provisions of the Division 1 contract requirements.

B. Product Data - Provide manufacturer’s data on product characteristics, performance criteria, limitations, and installation methods.

C. Submit a letter from the manufacturer of compliance with NFPA 284 compliance for above-grade walls

1.05. ENVIRONMENTAL REQUIREMENTS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

1.06. COORDINATION

A. Coordinate work under provisions of the Division 1 contract requirements.

B. Coordinate the work with Section 07530, EPDM Membrane Roofing, for installation of vapor retarder and mastic adhesive.

PART 2 PRODUCTS

2.01. MANUFACTURERS - INSULATION MATERIALS

A. Dow Chemical Company.

B. Owens Corning.

C. Johns-Manville.

D. Substitutions - Under provisions of the Division 1 contract requirements.

2.02. INSULATION MATERIALS

A. Polystyrene Insulation - ASTM C578 Type IV or Type VI; extruded cellular type, conforming to the following minimum criteria: (or as noted on construction drawings)

Thermal Resistance	R of 5.0 per inch
Thickness	Cavity walls – To Be Determined
Board Size	24 x 96 inch at foundation walls; 16 x 96 inch at cavity walls
Compressive Strength	Minimum 25 psi for cavity wall installation (Type IV); minimum 40 psi for below-grade installation (Type VI)
Water Absorption	In accordance with ASTM C272 0.3 percent by volume maximum (both types)
Water Vapor Permeance	1.1 maximum in accordance with ASTM E96 (both types)
Edges	Square edges

2.03. ADHESIVE

A. Adhesive - Fibered asphalt emulsion mastic conforming to ASTM D1187 Type I and ASTM D1227 Type II, Class 1. Adhesive to be compatibility with AVB above-grade, and compatibility with waterproofing below grade

1. Karnak Corporation 920AF, Clark, NJ.

2. Sonneborn Hydrocide 700, Shakopee, MN.

3. Dow Corning Corporation, Auburn, MI.

4. Approved equal as per insulation manufacturer recommendations.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify site conditions under provisions of the Division 1 contract requirements.

B. Verify that substrate, adjacent materials, and insulation boards are dry and ready to receive insulation and adhesive.

C. Verify substrate surface is flat, free of honeycomb, fins, irregularities, materials or substances that may impede adhesive bond.

3.02. INSTALLATION

A. Cavity Walls

1. Verify that masonry veneer ties are in place and properly spaced before applying vapor retarder/adhesive.

2. Trowel on a full and continuous coating of vapor retarder/adhesive to the outside face of the inner wythe of the cavity wall. Apply at a coverage of 4 to 6 gallons per 100 square feet.

3. Once the continuous coating of vapor retarder and mastic adhesive has cured, apply 4-inch diameter spots of adhesive to walls 16 inches on center both ways. Press insulation firmly into adhesive immediately after placement of adhesive.

4. Fit insulation tightly around masonry veneer ties and other interruptions in the wall surface.

3.03. PROTECTION OF FINISHED WORK

A. Protect finished work under provisions of the Division 1 contract requirements.

B. Do not permit work to be damaged prior to covering insulation.

END OF SECTION

SECTION 07530

EPDM MEMBRANE ROOFING

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Furnish and install roof system over precast concrete plank and existing roof structures.

1. New

a. Vapor retarder.

b. Rigid board insulation.

c. Insulation cover board.

d. Adhesives.

e. Membrane roofing.

f. Base flashings.

g. Counterflashings.

h. Termination and anchoring accessories.

i. Sealants.

2. Installation of aluminum fascia system, scupper boxes, and downspouts; prefabricated equipment curbs; blocking, and fasteners if required.

a. Furnished under Section 07710, Manufactured Roof Specialties

3. All other components required to create a complete, watertight, and warranted roof.

4. Flashing for roof penetrations.

1.02. REFERENCES

A. ASTM C177 - Thermal Insulation; Building Seals and Sealants

B. ASTM C236 – Standard Test Method for Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box (withdrawn 2001, replaced by ASTM C1363)

C. ASTM C355 – Test Methods for Test for Water Vapor Transmission of Thick Materials (withdrawn 1982, replaced by ASTM E96)

D. ASTM C1289 – Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board

E. ASTM C1363 – Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus

F. ASTM D412 - Standard Test Method for Vulcanized Rubber and Thermoplastic Elastomers – Tension

G. ASTM D471 – Standard Test Method for Rubber Property – Effect of Liquid

H. ASTM D573 – Standard Test Method for Rubber – Deterioration in an Air Oven

I. ASTM D624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers

J. ASTM D746 – Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

K. ASTM D1149 – Standard Test Methods for Rubber Deterioration – Cracking in an Ozone Controlled Environment

L. ASTM D2137 – Standard Test Methods for Rubber Property-Brittleness Point of Flexible Polymers and Coated Fabrics

M. ASTM D2240 - Standard Test Method for Rubber Property - Durometer Hardness

N. ASTM E96 - Standard Test Method for Water Vapor Transmission of Materials

O. ASTM E136- Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750° C

P. Underwriters Laboratories (UL) - Fire Resistance Directory

1.03. SYSTEM DESCRIPTION

A. Major system components are described below. The work includes all components necessary to provide a weather tight and warranted roof.

1. Vapor Retarder - The vapor retarder shall be a system recommended by the roof membrane manufacturer and approved by the roof manufacturer as part of a system meeting wind uplift and warranty requirements. The vapor retarder shall provide a continuous and well-secured barrier to water and water vapor.

a. At concrete roof decks, the system shall be directly adhered to concrete, including required primers for application.

2. Insulation – Flat and tapered boards of rigid polyisocyanurate insulation, secured to the vapor retarder and to each other with a two-component urethane foam adhesive.

3. Insulation Cover Board - Glass mat water-resistant gypsum board or other manufacturer-approved product as required to obtain system approval and warranty by membrane manufacturer.

4. Roof Membrane – Fully adhered roofing system secured to the insulation cover board with two-component urethane foam adhesive or manufacturer recommended adhesive.

a. Sure-Seal (EPDM) by Carlisle (.0.60 mil, non-reinforced).

b. RubberGard (EPDM) by Firestone (.060 mil, non-reinforced).

c. Versigard (EPDM) by Versico (.060 mil, non-reinforced).

5. Flashings, blocking, termination accessories, adhesives, sealants, walk pads, and all other components needed to provide a complete warranted and weathertight roof.

1.04. QUALITY CONTROL

A. Submit all copies of complete submittals to roofing manufacturer for their approval prior to submission to Engineer. Once approved by manufacturer, submit copies of complete submittal to Engineer.

B. Manufacturer's approval of submittal must be clearly indicated before review by the Engineer will occur. Roofing manufacturer shall review and approve all roofing components. When membrane manufacturer is not the producer of substrate elements, i.e., insulation, separation mats, etc., each manufacturer shall approve the other in writing.

1.05. SUBMITTALS

A. Submittal shall include the following:

1. Product data sheets on each product proposed for use as part of the roof system.

2. Shop Drawings

a. Roof plan(s) drawn to scale.

b. Large-scale drawings showing standard and special details that include conditions of interface with the specific construction design depicted by the documents for this project. These shall include, but not be limited to:

1) Flashing at roof perimeter.

2) Flashing at all different types of roof penetrations.

3) Connection to roof drains.

4) Connection to overflow drains or scuppers.

3. Samples (two 6-inch by 6-inch pieces each of items applicable to project)

a. Membrane.

b. Flashing - each type.

c. Insulation - each type.

d. Insulation cover board.

e. Thermal barrier.

f. Vapor retarder.

4. Letter from manufacturer including the following:

   a. Statement that the applicator has been trained and approved by the roofing manufacturer to install the system as submitted.

   b. Statement that the roof system has been designed to resist loads as required by the current New York State Building Code and for the terrain and exposure conditions applicable to this project.

   c. Statement that the roof systems, as submitted by the Contractor and reviewed by the manufacturer, is warrantable after manufacturer's final inspection and correction of any defects identified by that inspection.

5. Sample warranty fully executed, with any and all amendments, except for signatures and acceptance dates.

6. Manufacturer's Field Inspection Reports – Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and special environmental conditions Data to be collected by manufacturer's representative and submitted Engineer by Contractor.

1.06. PRE-INSTALLATION CONFERENCE

A. Prior to scheduled commencement of the roofing installation and associated work, conduct a meeting at the project site with the installer, Engineer, Owner, roofing manufacturer's representative, and any other persons directly involved with the performance of the work. The installer shall record conference discussions to include decisions and agreements reached (or disagreements) and furnish copies of recorded discussions to each attending party. The main purpose of this meeting is to review foreseeable methods and procedures related to roofing work.

1.07. DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact. Record lot numbers and dates for future reference, should materials prove defective.

B. Store products in weather protected environment, clear of ground and moisture. Store adhesives, caulking, primers, etc., at room temperature (60 to 80 degrees F).

1.08. ENVIRONMENTAL REQUIREMENTS

A. Do not apply roofing components during wet or inclement weather, or during periods when ambient temperatures are, or are projected to be, below or above those recommended by the roofing manufacturer.

B. Do not apply roofing components to damp or frozen substrates.

C. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

D. Do not allow products deleterious to the membrane to come in direct contact with membrane.

E. No work shall be performed under any conditions for which the Contractor is not willing to place his guarantee.

1.09. COORDINATION

A. Coordinate work with all trades to insure roof penetrations have the proper flashings to preserve warrantability of new roof system. Coordinate work with all trades to minimize traffic on completed roofing areas.

1.10. WARRANTY

A. In addition to the manufacturer's standard warranty, the manufacturer shall provide a 15-year total roofing system warranty with extended peak gust wind speed coverage for winds of up to 120 miles per hour.

B. Warranty to commence following final inspection by the roofing manufacturer's inspector. Two fully executed copies of the warranty document shall be delivered to the Engineer.

C. In the event of a wind-related problem, wind speed shall be determined by the U.S. Weather Station nearest to the site.

PART 2 PRODUCTS

2.01. MANUFACTURER

A. Roofing membrane material to be 0.060 mil non-reinforced EPDM provided by Carlisle Syntec, Firestone, or Versico.

B. Roofing assembly to be as provided and approved by named manufacturer. Components meeting requirements in the following Articles to create a complete, watertight, and warranted roof.

2.02. MEMBRANE MATERIAL - EPDM

A. Membrane to be free of streaks, particles of foreign matter, pinholes, cracks, tears, and shall be uniform thickness.

B. When unrolled in the relaxed position, membrane shall be free of wrinkles, distortions and blisters.

C. Membrane, to be non-reinforced EPDM, 0.060 mils and meeting the following physical properties:

Physical Property	Test Method	Performance Values Exceed ASTM .060
Tensile Strength	ASTM D412	1500 psi
Elongation	ASTM D412	500 percent
Tear Resistance	ASTM D624	200 lbf/in
Ozone Resistance	ASTM D1149	No cracks
Heat Aging 28 Days at 240° F per ASTM D-573	ASTM D573 ASTM D412	Tensile strength - Minimum 1400 PLF Elongation - Minimum 250

Physical Property	Test Method	Performance Values Exceed ASTM .060
		percent
Brittleness Temperature	ASTM D2137	-49° F
Water Resistance (change in weight after immersion 7 days at 150° F)	ASTM D471	+2 percent
Water Vapor Permeability Maximum, perm mils	ASTM E96	0.03 or less
Thickness Tolerance	ASTM D412	+10%

2.03. FLASHINGS

A. Flashings to be reinforced and unreinforced EPDM. Use premolded fabricated shapes on corners, pipes, and tubing or difficult turns.

1. Tensile Strength - 1300 psi (minimum), ASTM D412.

2. Elongation - 300 percent (minimum), ASTM D412.

3. Brittleness Temperature - -49 degrees F, ASTM D746.

4. Tear Resistance - 150 lbs/in (minimum), ASTM D624.

5. Thickness - 0.060-inch.

B. Prefabricated boot Flashings – Use for vent pipes, conduits, and other roof penetrations. To be provided by roofing manufacturer. Install 8 inches minimum above finished membrane.

C. Flexible Flashings - As recommended or supplied by the roofing manufacturer.

2.04. RELATED MATERIALS

A. Bonding Adhesive - Compatible with materials to which membrane is to be bonded; furnished by roofing membrane manufacturer.

B. Cleaner/Primer - Wash supplied by manufacturer to remove weathering or other substances from membrane surface in preparation for splicing, bonding or tapes.

C. Pourable Sealer - Formula compatible with membrane, supplied by roofing membrane manufacturer.

D. Sponge Tubing and Compressible Filler - As recommended by roofing membrane manufacturer.

E. Splice adhesive, to be furnished by roofing membrane manufacturer.

F. Edge Sealant and Water Block Seal - Shall be compatible with materials with which they are used and supplied by roofing manufacturer.

G. Wood Nailers – Preservative treated as specified in Section 06112, Framing and Sheathing.

2.05. VAPOR RETARDER

A. System recommended by the roof membrane manufacturer, and approved by the roof manufacturer as part of a system meeting wind uplift and warranty requirements. The vapor retarder shall provide a continuous and well-secured barrier to water and water vapor.

2.06. INSULATION RETENTION COVER

A. Insulation Retention Cover - Membrane manufacturer-approved 1/2-inch thick glass mat water resistant gypsum board.

1. Insulation retention cover to be adhesively secured to insulation.

2.07. INSULATION

A. Insulation – Closed-cell polyisocyanurate foam core laminated to a glass reinforced mat facer. Approved or supplied by roofing system manufacturer.

1. Board Density - 2 lbs/cubic foot.

2. Board Size - Largest board that fully and firmly attaches to substrate. Use smaller boards if irregularities are too great

3. Board Thickness

a. Flat boards. Minimum of 1-1/2-inch thickness per layer. Boards to be layered to achieve a minimum overall thickness in roof field of 5 inches.

b. Tapered boards. Boards to be layered with flat boards to achieve the minimum thickness as indicated on drawings, while providing minimum slope to drain of 1/4-inch per foot in roof field. Drainage to approximate drainage patterns as shown on roof plans.

4. Thermal Conductivity - Six-month conditioned R factor of 6.00 per inch at 75 degrees F mean temperature, as determined by ASTM C236.

5. Board Edges - Square cut (diagonal dimension 1/4-inch maximum and ends not more than 1/8-inch maximum out of square).

6. Compressive Strength - 25 psi.

7. Water Vapor Permeance - 2.0 or less per ASTM C355.

2.08. INSULATION AND MEMBRANE ADHESIVE

A. Two-component low-rise urethane foam adhesive.

B. Accepted by the roof membrane and insulation manufacturers as a component in a roof system warranted as required by this section.

C. Fully compatible with, and effective in adhering to, the vapor retarder.

2.09. FASCIA SYSTEM, SCUPPER BOXES, AND DOWNSPOUTS

A. Per Section 07710, Manufactured Roof Specialties.

2.10. WOOD BLOCKING

A. Per Section 06112, Framing and Sheathing.

PART 3 EXECUTION

3.01. EXAMINATION

A. Ensure that deck is supported and secure; surfaces and site conditions are ready to receive work.

B. Ensure deck is clean and smooth, free of depressions, waves, or projections.

C. Ensure deck surfaces are adequately dry and free of snow or ice to receive the work, including fasteners, adhesives, etc. Snow removal or cleaning to be performed by roofing contractor without extra payment as part of contract.

D. Verify that all roof openings, curbs, pipes, sleeves, ducts, vents through roof, and wood nailing strips are solidly set.

E. Notify Engineer immediately of any conditions that might potentially compromise either the performance of the roof system or the warranty of the roof system.

3.02. VAPOR RETARDER APPLICATION

A. Apply vapor retarder to deck surface with adhesive in accordance with manufacturer's instructions and these specifications

B. Extend vapor retarder to roof edge and bring down the vertical face of blocking, as shown on the Contract Drawings.

3.03. INSULATION APPLICATION

A. Install insulation in accordance with roofing membrane manufacturer's and insulation manufacturer's instructions, and these specifications. Adhere layers of insulation to vapor retarder and to each other with adhesive in a manner approved by the roofing membrane manufacturer to attain the specified warranties.

B. Do not install pieces of insulation less than 12 inches in any dimension.

C. Install tight to blocking and roof penetrations.

D. Apply no more insulation than can be covered with membrane in same day. If insulation becomes wet for any reason, remove and replace at no expense to the Owner.

E. All joints between layers to be staggered. Place edge joints on and parallel to deck ribs.

F. Provide a 3-foot by 3-foot tapered sump centered on each roof drain.

G. Place tapered insulation system above vapor retarder and roof deck, then cover with layer of manufacturer-approved retention board per Article 2.06, followed by membrane application.

3.04. MEMBRANE APPLICATION

A. Apply membrane in accordance with manufacturer's instructions. Membrane joints to be fully completed each day, including each seam in each roof area, with all seam adhesives and seam sealants.

B. Roll out membrane, free from wrinkles or tears. Place sheet without stretching.

C. Overlap edges and ends a minimum of 3 inches and apply splicing cement. Prior to closing splice, apply in-seam sealant. Close splice and seal with continuous bead of lap sealant (seal permanently waterproof). Self-adhesive flashing strips as furnished and approved by the roofing membrane manufacturer are acceptable where use of such materials complies with warranty requirements.

D. Shingle joints on sloped substrate in direction of drainage; apply joint sealant to provide watertight seal.

E. Seal membrane around roof penetrations.

3.05. FLASHINGS AND ACCESSORIES

A. Apply appropriate flashing to seal roofing where vertical elements such as electrical, mechanical, heating and ventilating, or structural components penetrate the roof system.

B. Install roofing expansion joints as indicated in accordance with manufacturer's instructions or recommendations.

C. Coordinate installation of scupper (where indicated), elevated pipe, H&V unit frames, electrical components, and related flashings.

D. Install parapet flashing/roof edge. Coordinate with installation of scuppers and downspouts per manufacturer's instructions and approved shop drawing.

3.06. FIELD QUALITY CONTROL

A. Field inspection shall be performed following pre-construction meeting or beginning of installation, during installation, and prior to final acceptance; and at other intervals as required by roofing manufacturer to obtain warranty.

B. Correct identified defects or irregularities.

C. Entire roof membrane shall be tested for watertightness prior to acceptance of. Leak test membrane and scuppers with water for 24 hours.

1. Measure water levels at the beginning and end of 24-hour period.

2. If precipitation occurs during the test period, repeat test.

3. If water level falls, remove water, thoroughly dry, inspect installation then repair or replace roofing.

4. Repeat test until there is no leakage. Water levels must be above membrane at scupper, to test seal between membrane and scupper.

3.07. CLEANING

A. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.

B. Repair or replace defaced or disfigured finishes caused by work of this section.

3.08. PROTECTION

A. Protect building surfaces against damage from roofing work, which may include complete covering with tarps.

B. Where traffic must continue over finished roof membrane, protect surfaces with 3/4-inch plywood by 8-foot wide (minimum).

END OF SECTION

SECTION 07710

MANUFACTURED ROOF SPECIALTIES

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Provide and install manufactured roof specialties including preformed fascia and all other required accessories in accordance with the Contract Documents.

1.02. REFERENCES

A. AAMA 2605 – Voluntary Specifications, Performance Requirements, and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels

B. AISI (American Iron and Steel Institute) - Stainless Steel Uses in Architecture

C. NRCA (National Roofing Contractors Association) - Roofing and Waterproofing Manual

D. SMACNA - Architectural Sheet Metal Manual

E. Factory Mutual Research Corporation Approval Guide

F. ASTM D5643 - Standard Specification for Asphalt Roof Cement

1.03. SUBMITTALS

A. Provide in accordance with Section 01300, Submittals, and as supplemented herein. Submittals shall include, but not be limited to, the following:

1. Product Data - Provide data on shape of components, materials and finishes, anchor types and locations.

2. Samples – Submit two samples, 6 inches long in size illustrating component shape, finish, and color of fascia.

1.04. QUALITY ASSURANCE

A. Perform work in accordance with AISI, SMACNA, and NRCA details.

PART 2 PRODUCTS

2.01. PREFORMED FASCIA SYSTEM

A. Two-piece aluminum fascia cover, .040-inch thick.

B. Retainer Baseplate - Galvanized steel or extruded aluminum, pre-punched for fasteners.

C. Fascia Cover Finish - Superior performance organic coating meeting or exceeding requirements of AAMA A2605.

D. System listed in current Factory Mutual Research Corporation Approval Guide as approved for FM 1-90.

E. No exposed fasteners.

F. Accepted and warranted by roof membrane manufacturer as a component in the roof system.

G. Acceptable Manufacturer

1. TerminEdge as manufactured by W.P. Hickman Company, Ashville, NC.

2. Anchor-Tite as manufactured by Metal-Era, Inc., Waukesha, WI.

3. Or equal.

H. Accessories

1. Sealant - Same as specified in Section 07900, Joint Sealers.

2. Roofing Cement - Meeting requirements of roofing membrane manufacturer.

2.02. OVERFLOW (WALL) SCUPPER BOX

A. All-welded aluminum construction, 0.063-inch thickness.

B. Wall flange to be positioned as shown on Contract Drawings.

C. Scupper box outlet to fit inside downspout leader.

D. Scupper to be sealed tightly to the roof membrane and exterior wall system.

E. Scupper box finish to match that of the downspout.

F. Metal-Era or equal.

2.03. ALUMINUM TWO-PART COUNTERFLASHING

A. Two-part reglet and flashing system equal to Fry Reglet Corp. Springlock Flashing System with Type SM reglet.

1. 0.040-inch aluminum with gray polyester coating.

2.04. ACCESSORIES

A. Sealant – Same as specified in Section 07900, Joint Sealers.

B. Roofing Cement – ASTM D2822, Type 1, cutback asphalt type.

2.05. FINISHES

A. Aluminum – Finish and color as indicated in this section.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify that deck, curbs, roofing membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.

3.02. INSTALLATION

A. Install components in accordance with manufacturer’s instructions and secure downspouts and leaders at 4 feet 0 inches OC maximum.

B. Coordinate installation of components of this section with installation of insulated precast concrete wall panels, corrugated metal siding, and roofing membrane.

C. Install components of this section in accordance with approved submittals.

D. Coordinate installation of sealants and roofing cement with work of this section to ensure watertightness.

END OF SECTION

SECTION 07720

ROOF ACCESSORIES

PART 1 GENERAL

1.01. SUMMARY

A. Section Includes:

1. Roof curbs

2. Roof hatches

1.02. COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

1.03. ACTION SUBMITTALS

A. Product Data: For each type of roof accessory.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof accessories.

1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

C. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

D. Delegated Design Submittals: For roof curbs 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 mounting, securing, and flashing of roof-mounted items to roof structure. Indicate coordinating requirements with roof membrane system.

2. Wind-Restraint Details: Detail fabrication and attachment of wind restraints. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.04. INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:

1. Size and location of roof accessories specified in this Section.

2. Method of attaching roof accessories to roof or building structure.

3. Required clearances.

B. Sample Warranties: For manufacturer's special warranties.

1.05. CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.06. WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested according to ASTM D2244.

b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.

c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01. PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories to withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer to design roof curbs to comply with wind performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Wind-Restraint Performance: As indicated on Drawings.

2.02. ROOF CURBS

A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, straight sides, and integrally formed deck-mounting flange at perimeter bottom.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Supported Load Capacity: Coordinate load capacity with information on Shop Drawings of equipment to be supported.

D. Aluminum-zinc alloy-coated steel sheet, 0.064 inch thick.

1. Finish: Mill Color anodic.

E. Construction:

1. Curb Profile: Manufacturer's standard compatible with roofing system.

2. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.

3. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.

4. Insulation: Factory insulated with 1-1/2-inch-thick glass-fiber board insulation.

5. Liner: Same material as curb, of manufacturer's standard thickness and finish.

6. Nailer: Factory-installed wood nailer along top flange of curb, continuous around curb perimeter.

7. Retain "Platform Cap" Subparagraph below if required by supported equipment configuration; consult Project HVAC engineer.

8. Platform Cap: Where portion of roof curb is not covered by equipment, provide weathertight platform cap formed from 3/4-inch-thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.

9. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.

2.03. ROOF HATCHES

A. Roof Hatches: Metal roof-hatch units with lids and insulated single-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing, and weathertight perimeter gasketing, straight sides, and integrally formed deck-mounting flange at perimeter bottom.

B. Type and Size:

1. As per existing openings

C. Loads: Minimum 40-lbf/sq. ft. external live load and 20-lbf/sq. ft. internal uplift load.

D. Hatch Material, Steel: Aluminum-zinc alloy-coated steel sheet.

1. Thickness: Manufacturer's standard thickness for hatch size indicated.

2. Finish: Mill phosphatized

E. Hatch Material, Aluminum:

1. Thickness: Manufacturer's standard thickness for hatch size indicated.

2. Finish: Mill Clear anodic.

F. Hatch Material, Stainless Steel:

1. Thickness: Manufacturer's standard thickness for hatch size indicated 0.0781 inch.

G. Construction:

1. Insulation: 1-inch-thick, cellulosic-fiber board.

a. R-Value: 4.3 according to ASTM C1363.

2. Nailer: Factory-installed wood nailer continuous around hatch perimeter.

3. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.

4. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.

5. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.

H. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.

1. Height: 42 inches above finished roof deck.

2. Posts and Rails: Galvanized-steel pipe, 1-1/4 inches in diameter, in diameter.

3. Flat Bar: Galvanized steel, 2 inches high by 3/8 inch thick.

4. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches in diameter.

5. Chain Pass way Barrier: Galvanized proof coil chain with quick link on fixed end.

6. Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.

7. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.

8. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.

9. Fabricate joints exposed to weather to be watertight.

10. Fasteners: Manufacturer's standard, finished to match railing system.

11. Finish: Manufacturer's standard.

I. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.

1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.

2. Height: 42 inches above finished roof deck.

3. Material: Steel tube.

PART 3 EXECUTION

3.01. EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

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

3.02. INSTALLATION

A. Install roof accessories according to manufacturer's written instructions.

1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.

2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.

3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.

4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.

2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.

3. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

C. Roof Curb Installation: Install each roof curb so top surface is level.

D. Roof-Hatch Installation:

1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.

2. Attach safety railing system to roof-hatch curb.

3. Attach ladder-assist post according to manufacturer's written instructions.

3.03. REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A780/A780M.

B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 09900 - Painting.

C. Clean exposed surfaces according to manufacturer's written instructions.

D. Clean off excess sealants.

E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07840

PENETRATION FIRESTOPPING

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Furnish and install firestop systems consisting of a material, or combination of materials, installed to retain the integrity of fire resistance rated construction by maintaining an effective barrier against the spread of flame, smoke and/or hot gases through penetrations, blank openings, construction joints, fire-resistive joints, and perimeter openings in or adjacent to fire-rated barriers in accordance with the requirements of the Building Code for this project.

B. Firestop systems shall be used in locations including, but not limited to, the following:

1. Penetrations through fire resistance rated floor and roof assemblies requiring protected openings, including both empty openings and openings containing penetrants.

2. Penetrations through fire resistance rated wall assemblies including both empty openings and openings containing penetrants.

3. Membrane penetrations in fire resistance rated wall assemblies where items penetrate one side of the barrier.

4. Joints between fire resistance rated assemblies.

5. Perimeter gaps between rated floors/roofs and an exterior (rated and non-rated) wall assembly.

1.02. REFERENCES

A. American Society For Testing and Materials Standards (ASTM)

1. ASTM E84 - Standard Test Method For Surface Burning Characteristics of Building Materials.

2. ASTM E119 - Methods of Fire Tests of Building Construction and Materials.

3. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C.

4. ASTM E814 - Standard Test Method For Fire Tests of Through-Penetration Firestops.

5. ASTM E1399 - Test Method for Cyclic Movement and Measuring Minimum and Maximum Joint Width.

6. ASTM E1966 - Test Method For Resistance of Building Joint Systems.

7. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Fire Stops.

8. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-Story Test Apparatus.

9. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.

B. Underwriters Laboratories Inc. (UL)

1. UL 263 - Fire Tests of Building Construction and Materials.

2. UL 723 - Surface Burning Characteristics of Building Materials.

3. UL 1479 - Fire Tests of Through-Penetration Fire Stops.

4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.

C. UL Fire Resistance Directory - Volume 2

1. Through-Penetration Firestop Devices (XHJI).

2. Fire Resistive Ratings (BXUV).

3. Through-Penetration Firestop Systems (XHEZ).

4. Fill, Void, or Cavity Material (XHHW).

5. Perimeter Barrier (Fire Containment) System (XHDG).

6. Forming Materials (XHKU).

7. Curtain Wall Insulation (XHGU).

D. UL Building Materials Directory

E. Omega Point Laboratories (OPL) - Directory of Listed Building Products, Materials & Assemblies, Volume II

F. UL Qualified Firestop Contractor Program

G. Warnock Hersey (WH) - Certification and Listings Directory

H. NFPA - NFPA 101: Life Safety Code

I. NFPA 285, “Tests for Evaluation of Flammability Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components Using the Intermediate-Scale, Multi-Story Test Apparatus”

J. Current Building Code of New York State and referenced standards

1.03. DEFINITIONS

A. Firestopping - The use of a material or combination of materials in a fire-rated structure (wall or floor) where it has been breached, so as to restore the integrity of the fire rating of that wall or floor.

B. System - The use of a specific firestop material or combination of materials around a specific penetrant(s) or into a specific joint in conjunction with a specific wall and/or floor construction type.

C. Barrier - Any bearing or non-bearing wall or floor that has an hourly fire and smoke rating.

D. Through-penetration - Any penetration of a fire-rated wall or floor that completely breaches the barrier.

E. Membrane-penetration - Any penetration in a fire-rated wall that breaches only one side of the barrier.

F. Fire-Resistive Joint - Any gap, joint, or opening, whether static or dynamic, between two fire- rated barriers including where the top of a wall meets a floor; wall edge to wall edge configurations; floor edge to floor edge configurations; floor edge to wall configurations.

G. Perimeter Barrier - Any gap, joint, or opening, whether static or dynamic, between a fire-rated floor assembly and a non-rated exterior wall assembly.

H. Engineering Judgment (EJ) - A firestopping assembly proposed for conditions where a tested and listed firestopping system does not exist.

1.04. PERFORMANCE REQUIREMENTS

A. Penetrations - Provide and install through-penetration firestop systems that are produced to resist the spread of fire, passage of smoke and other gases according to requirements indicated, to restore the original fire-resistance rating of barrier penetrated.

1. Provide and install complete penetration firestopping systems that have been tested and approved by nationally accepted testing agencies per ASTM E814 or UL 1479 fire tests in a configuration that is representative of field conditions.

2. F-Rated Systems - Provide through-penetration firestop systems with F ratings indicated, as determined per ASTM E814 or UL 1479, but not less than 1 hour or the fire resistance rating of the barrier being penetrated.

3. T-Rated Systems - Provide through-penetration firestop systems with T ratings indicated, as well as F-ratings, as determined per ASTM E814 or UL 1479, where required by the Building Code.

4. L-Rated Systems - Provide through-penetration firestop systems with L ratings in addition to F and T ratings, as determined per UL 1479, where required by the Building Code.

5. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems (W-rated systems) as determined per UL 1479, where indicated.

6. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of piping insulation.

B. Fire-Resistive Joints - Provide joint systems with fire resistance assembly ratings indicated, as determined by UL 2079 (ASTM E1399 and E1966), but not less than the fire resistance rating of the construction in which the joint occurs. Firestopping assemblies must be capable of withstanding anticipated movements for the installed field conditions.

1. For firestopping assemblies exposed to view, traffic, moisture, and physical damage, provide products that after curing do not deteriorate when exposed to these conditions both during and after construction.

2. For floor penetrations exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved either by installing floor plates or by other means.

C. Building Perimeter Barrier (Fire Containment) Systems - Provide interior perimeter joint systems with fire resistance ratings indicated as determined per ASTM E2307, but not less than the fire resistance rating of the floor construction.

1. Provide products that upon curing, do not re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, ponding water or other forms of moisture characteristic during and after construction.

2. Provide sealants sufficiently flexible to accommodate movement such as thermal expansion, inter-story differential building sway and other normal building movement without damage to the seal.

3. Provide perimeter fire containment systems subjected to an air leakage test conducted in accordance with Standard, ANSI/UL2079 with published L-Ratings for ambient and elevated temperatures as evidence of the ability of the fire-resistive joint system to restrict the movement of smoke.

D. Firestopping products shall have flame spread ratings less than 25 and smoke-developed ratings less than 450, as determined per ASTM E84.

E. Where there is no specific third-party tested and classified firestop system available for a particular firestop configuration/condition, the firestopping contractor shall obtain from the firestopping material manufacturer an EJ or Equivalent Fire Resistance Rated Assembly (EFRRA) to be submitted to the approving authority and authority having jurisdiction for approval prior to installation. The EJ shall follow International Firestop Council (IFC) guidelines.

1.05. SUBMITTALS

A. Provide in accordance with Section 01300, Submittals, and as supplemented herein. Submittals shall include, but not be limited to, the following:

1. Product Data - For each type of firestopping and/or barrier system product selected. Certify that firestopping materials are asbestos free and contain volatile organic compounds within limits of the local jurisdiction and are non-toxic to building occupants.

2. Design Listings - Submit system design listings, including illustrations, from a qualified testing and inspecting agency that is applicable to each firestop configuration.

3. Where there is no specific third party tested and classified firestop system available for a particular configuration, the firestopping contractor shall obtain from the firestopping material manufacturer an EJ or EFRRA for submittal.

4. Qualification Data - For firms and persons specified in Article 1.07 to demonstrate their capabilities and experience. Submit document from manufacturer wherein manufacturer recognizes the installer as qualified.

1.06. QUALITY ASSURANCE

A. Provide firestopping and/or perimeter barrier system design listings from UL or OPL in accordance with the appropriate ASTM Standard(s) per Article 1.05.

B. Contractor Qualifications - An acceptable installer shall meet any two of the following requirements:

1. Licensed by state or local authority where applicable.

2. Trained and approved by the firestop manufacturer.

3. Shown to have successfully completed not less than five comparable scale projects.

4. FM approved in accordance with FM Standard 4991, Approval of Firestop Contractors.

5. UL Qualified Firestop Contractor.

C. Single Source Limitations - Obtain firestop systems, for each kind of penetration and construction condition indicated from a single manufacturer.

D. Materials from different firestop manufacturers shall not be installed in the same firestop system or opening.

E. Firestopping material shall be asbestos-free and lead-free and shall not incorporate nor require the use of hazardous solvents.

F. Firestopping sealants must be flexible, allowing for normal movement of adjacent materials.

G. Firestopping materials shall not crack or pull back from contact surfaces such that a void is created.

H. Firestopping materials shall be moisture resistant, and may not dissolve in water after curing.

I. Materials used shall be in accordance with the manufacturer’s written installation instructions.

J. Label each firestopping system installation with the following information:

1. Firestopping product name.

2. System listing number.

3. Name and address of manufacturer

K. Inspection of penetrations through fire rated floor and wall assemblies shall be in accordance with ASTM E2174, Standard Practice for On-Site Inspection of Installed Fire Stops.

L. Inspection of fire-resistive joints and perimeter barriers shall be in accordance with ASTM E2393, Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.

1. Firestopping tests are performed by a qualified, testing and inspection agency. A qualified testing and inspection agency is UL or another agency performing testing and follow-up inspection services for perimeter fire containment systems acceptable to authorities having jurisdiction.

2. Perimeter fire containment system products bear classification marking of qualified testing and inspection agency.

1.07. DELIVERY, STORAGE, AND HANDLING

A. Deliver firestopping products to project site in original, unopened containers or packages with intact and legible manufacturer's labels identifying product and manufacturer, date of manufacture, lot number, UL or OPL classification marking, and mixing instructions for multi- component materials.

B. Store and handle materials per manufacturer's instructions to prevent deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

C. All firestop materials shall be installed prior to expiration of shelf life.

1.08. PROJECT CONDITIONS

A. Environmental Limitations - Install firestopping when ambient or substrate temperatures are within limits permitted by the manufacturer's written instructions. Do not install firestopping when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate per the manufacturer's written instructions on the product's Material Safety Data Sheet.

C. Verify the condition of the substrates before starting work.

D. Care should be taken to ensure that firestopping materials are installed so as not to contaminate adjacent surfaces.

1.10. SEQUENCING

A. Sequence work to permit installation of materials in conjunction with other materials and seals.

1.11. COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that firestopping assemblies are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

C. Do not conceal firestopping installations until the Owner's inspection agency or authorities having jurisdiction have examined each installation.

D. Schedule firestopping after installation of penetrants but prior to concealing the openings.

PART 2 PRODUCTS

2.01. FIRESTOPPING, GENERAL

A. Firestopping products specified in system design listings by UL or OPL may be used providing they conform to the construction type, penetrant type, annular space requirements and fire rating involved in each separate assembly.

B. Manufacturer of firestopping products shall have been successfully producing and supplying these products for a period of not less than three years and be able to show evidence of at least 10 projects where similar products have been installed and accepted.

C. Accessories - Provide components for each firestop system that are needed to install fill materials and to comply with Article 1.05. Use only components specified by the firestopping manufacturer and approved by UL or OPL for the firestop systems indicated. Accessories include, but are not limited to the following items:

1. Permanent forming/damming/backing materials, including the following:

a. Mineral wool insulation.

b. Foams or sealants used to prevent leakage of fill materials in liquid state.

c. Fire-rated form board.

d. Polyethylene/polyurethane backer rod.

e. Rigid polystyrene board.

2. Temporary forming materials.

3. Substrate primers.

4. Steel sleeves.

D. All firestopping products and systems shall be designed and installed so that the basic sealing system will allow the full restoration of the fire resistance properties of the barrier being penetrated with minimal repair if penetrants are subsequently removed.

2.02. MIXING

A. For those products requiring mixing before application, comply with firestopping manufacturer’s written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

2.03. MANUFACTURERS

A. Subject to compliance with the requirements, provide products by one of the following:

1. Specified Technologies, Inc., Somerville, NJ

2. 3M Fire Protection Products, St. Paul, MN

3. Hilti, Inc., Tulsa, OK

4. Thermafiber, LLC, Wabash, IN

5. Roxul, Inc., Milton, Ontario, CA

6. Owens Corning, Toledo, OH

7. Other manufacturers listed in the UL Fire Resistance Directory, Volume 2

8. Or equal

2.04. MATERIALS

A. General - Use only firestopping products that have been tested for specific fire resistance rated construction conditions conforming to construction assembly type, penetrating item type, or joint opening width and movement capabilities, annular space requirements, and fire rating involved for each separate instance.

1. Specific manufacturers' products listed serve as a basis for design. Similar systems by named manufacturers that meet performance criteria of that section are also acceptable.

B. Intumescent Firestop Sealants and Caulk - Single-component latex formulations that, upon cure, do not re-emulsify during exposure to moisture.

C. Elastomeric Water-Based Sealant - Single-component latex formulations that, upon cure, do not re-emulsify during exposure to moisture.

D. Elastomeric Silicone Sealant (Single-Component) - Moisture curing, single-component, silicone elastomeric sealant for horizontal surfaces (pourable or non-sag) or vertical surfaces (non-sag).

E. Silicone Foam - Multi-component, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

F. Firestop Putty and Pads

1. Putty - Intumescent, non-hardening, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

2. Putty Pads - Intumescent, non-hardening pads or inserts for protection of electrical switch and receptacle boxes to reduce horizontal separation to less than 24 inches.

G. Firestop Devices - Factory assembled steel collars lined to fit specific outside diameter of penetrating item.

H. Wrap Strips - Single-component intumescent strips faced on both sides with plastic film.

I. Firestop Mortars - Portland cement-based dry mix product formulated for mixing with water at project site to form a non-shrinking, water-resistant, homogeneous mortar.

J. Firestop Bags/Pillows - Re-enterable, non-curing, mineral fiber core encapsulated with an intumescent coating contained in a flame-retardant poly bag.

K. Elastomeric Coating - A water-based, spray-applied elastomeric coating for joints between fire-resistive assemblies and perimeter barriers that cures to a strong flexible seal, accommodating seismic, wind, and thermal contraction/expansion movement. Used with partially compressed mineral fiber backing.

L. Fire-Rated Cable Pathway - Modular devices composed of steel raceway with intumescent foam pads permitting 0 to 100 percent cable fill.

M. Curtain Wall Insulation - Faced or unfaced batts or blankets used for exterior curtain walls with the capacity to contribute to the fire resistance of the assembly.

N. Safing Insulation - Board or sheet products used as forming materials in slab edge openings with the capacity to provide a degree of the fire resistance required when used with an appropriate fill material..

PART 3 EXECUTION

3.01. EXAMINATION

A. Examine substrates and conditions for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance. Notify Engineer of any unsatisfactory conditions.

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

C. Verify that all pipes, conduits, cables, and/or other items which penetrate fire-rated construction have been permanently installed prior to installation of firestops.

3.02. PREPARATION

A. Surface Cleaning - Clean out openings immediately before installing firestop systems to comply with written recommendations of firestopping manufacturer and the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of firestop systems.

2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestop systems. Remove loose particles remaining from cleaning operation.

3. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellents, and any other substances that may inhibit optimum adhesion.

4. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.

3.03. PENETRATION FIRESTOP SYSTEMS

A. General - Install through-penetration firestop systems to comply with Article 1.05 and firestopping manufacturer’s written installation instructions and published drawings for products and applications indicated.

B. Installation of firestopping shall be performed by an applicator/installer qualified as described in Article 1.07.

C. Apply firestopping in accordance with UL or OPL listed system designs or manufacturer's EJ per the manufacturer's installation instructions.

D. Install forming/damming/backing materials and other accessories required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire resistance ratings required.

E. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.

2. Apply materials so they fully contact and adhere to substrates formed by openings and penetrating items.

3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.04. JOINT FIRESTOP SYSTEMS

A. General - Install fire-resistive joint firestop systems to comply with required codes and ratings and with Article 1.05 and firestopping manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Installation of firestopping shall be performed by an applicator/installer qualified as described in Article 1.07.

C. Apply firestopping in accordance with UL or OPL listed system designs or manufacturer's EJ per the manufacturer's installation instructions.

D. Install joint forming/damming materials and other accessories required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths of installed firestopping material relative to joint widths that allow optimum movement capability and achieve fire resistance ratings required.

E. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill joint as required to achieve fire-resistance ratings indicated.

2. Apply materials so they fully contact and adhere to substrates forming the openings.

3. Completely fill recesses provided for each joint configuration.

4. Tool non-sag firestop materials after their application and prior to the time skinning begins. Use tooling agents approved by the firestopping manufacturer.

3.05. PERIMETER BARRIER FIRESTOP SYSTEMS

A. General - Install perimeter barrier firestop systems to comply with required codes and ratings and with Article 1.05 and firestopping manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Installation of firestopping shall be performed by an applicator/installer qualified as described in Article 1.07.

C. Apply firestopping in accordance with UL or OPL listed system designs or manufacturer's EJ per the manufacturer's installation instructions.

D. Install metal framing, curtain wall insulation, mechanical attachments, safing materials, and firestop materials as applicable within the system design.

3.06. FIELD QUALITY CONTROL

A. Testing - The Owner will engage a qualified independent inspecting agency to inspect firestop systems, conduct material evaluation and application tests and prepare inspection reports. The Contractor shall cooperate fully and, when requested, permit samples of materials to be taken from original packaging as the materials are applied to building surfaces.

1. Inspection of completed installations of firestop systems shall take place in successive stages as installation of firestop systems proceeds. Do not proceed with installation of firestop systems for the next area until inspecting agency determines completed work shows compliance with requirements.

2. Inspection agency shall state in each report whether inspected firestop systems comply with or deviate from requirements.

B. Cost of Testing - If tests indicate that materials or work does not comply with requirements, the Contractor shall pay for tests performed, all retesting, and shall repair non-complying work. Where repair is not possible the Contractor shall remove and replace the firestop materials.

C. Proceed with enclosing firestop systems with other construction only after inspection reports are issued and firestop systems comply with requirements.

3.07. CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as work progresses by methods and with cleaning materials that are approved in writing by firestopping manufacturer(s) and that do not damage materials in which openings occur. Leave finished work in neat, clean condition with no evidence of spillovers or damage to adjacent surfaces.

B. Provide final protection and maintain conditions during and after installation that ensure firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestop systems immediately and install new materials to produce firestop systems complying with specified requirements.

END OF SECTION

SECTION 07900

JOINT SEALANTS

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Furnish and install joint sealers and accessories in accordance with the Contract Documents including, but not limited to the following:

1. Sealants and caulking for non-submerged uses.

2. Backer rods and accessories.

1.02. REFERENCES

A. ASTM C834 - Standard Specifications for Latex Sealants

B. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications

C. ASTM C920 - Standard Specification for Elastomeric Joint Sealants

D. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants

E. ASTM E1966 – Standard Test Method for Fire-Resistive Joint Systems

F. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials

G. SWRI - Sealant, Waterproofing Restoration Institute. ANSI A117.1 – Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People

1.03. SUBMITTALS

A. Provide in accordance with Section 01300, Submittals, and as supplemented herein. Submittals shall include, but not be limited to, the following:

B. Manufacturer’s Product Data – Manufacturer's literature describing performance characteristics validating product compliance with performance criteria specified and application procedures.

C. Samples – Submit samples illustrating manufacturer’s extended color range.

1.04. QUALITY ASSURANCE

A. Manufacturer Qualifications - Company regularly engaged in manufacturing and marketing of products specified in this section.

B. Installer Qualifications - Qualified to perform work specified by reason of experience or training provided by product manufacturer.

C. Installation per manufacturer’s instructions and SWRI.

D. Perform acoustical sealant application work in accordance with ASTM C919.

1.05. DELIVERY, STORAGE AND HANDLING

A. Deliver products in original factory packaging bearing identification of product, manufacturer, and batch number. Provide Material Safety Data Sheets for each product.

B. Store products in a location protected from freezing, damage, construction activity, precipitation, and direct sunlight in strict accordance with manufacturer's recommendations.

C. Condition products to approximately 60 to 70 degrees F for use in accordance with manufacturer's recommendations.

D. Handle all products with appropriate precautions and care as stated on Material Safety Data Sheets.

E. Do not use material that has exceeded manufacturer’s shelf life.

1.06. PROJECT CONDITIONS

A. Do not use products under conditions of precipitation or freezing weather. Use appropriate measures for protection and supplementary heating to ensure proper curing conditions in accordance with manufacturer's recommendations if application during inclement weather occurs.

B. Ensure substrate is dry.

C. Protect adjacent work from contamination due to mixing, handling, and application of flexible epoxy joint filler.

1.07. WARRANTY

A. Include coverage for replacement of sealant materials which fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

1.08. COORDINATION

A. Coordinate the work of this section with all sections referencing this section or referenced by this section.

B. Coordinate the work with existing opening construction and door hardware installation.

PART 2 PRODUCTS

2.01. MANUFACTURERS

A. Provide all joint sealers of the same type from a single manufacturer.

1. Manufacturer - Sika, BASF, Dow Corning, or equal.

B. Provide USDA and NSF approved sealants when indicated.

2.02. MATERIALS AND MANUFACTURERS

A. Multi-Component, Non-Sag Polyurethane Sealant - Sika Sikaflex 2cNS, BASF Sonolastic NP 2, or equal with +50 percent movement capability for vertical joints; ASTM C920, Type M, Grade NS, Class 25. USDA approved; SWRI validated; UL classified (fire resistance).

B. Two Component, Self-Leveling Polyurethane Sealant - Sika Sikaflex 2cSL, BASF Sonolastic SL 2, or equal with +25 percent movement capability for horizontal joints; ASTM C920, Type M, Grade P, Class 25; USDA approved.

C. Silicone Sealant - Sika SikaSil C990 or 995, BASF OmniPlus or Omniseal, Pecora 864, or equal. ASTM C920, Type S, Grade NS, Class 25 or 50.

D. Silicone Sealant Anti-Fungal - Sika S50, BASF Masterseal 121, Pecora 898NST, or equal. ASTM C920, Type S, Grade NS, Class 25 or 50.

E. Single Component Siliconized Acrylic Latex Sealant – BASF Sonolac, Bostik Chem-Calk 600, Pecora AC 20+ Silicone, or equal with +15 percent movement capability; ASTM C834.

F. Single Component pre-pressurized expanding polyurethane foam sealant equal to Sika “Sika Boom.”

G. Single Component Spray Applied Elastomeric Sealant – 3M Fire Dam Spray 200, Specified Technologies SpecSeal AS200, Tremco TremStop Acrylic SP; or equal with $\pm$25 percent movement capability; ASTM E84, max flame spread <25, smoke developed <50.

2.03. ACCESSORIES

A. Low VOC Primer - As recommended by manufacturer for particular sealant and substrate.

B. Joint Cleaner - Non-corrosive and non-staining type recommended by sealant manufacturer and compatible with joint forming materials.

C. Soft Backer Rod - Industrial Thermo Polymers Limited “104 Soft-Type Backer Rod,” Backer Rod Mfg. Inc. “Denver Foam” or equal; non-gassing, reticulated closed-cell polyethylene rod designed for use with cold-applied joint sealants.

1. Comply with ASTM C1330.

2. Size required for joint design.

D. Closed-Cell Backer Rod - Industrial Thermo Polymers Limited “101 Standard Backer Rod,” Deck-o-Seal “Kool-Rod” or equal closed-cell polyethylene rod designed for use with cold-applied joint sealants for on-grade or below-grade applications.

1. Comply with ASTM C1330.

2. Size required for joint design.

E. Joint Filler - Canzac “Expansion Joint Filler,” Sonneborn(R)/ChemRex "Expansion Joint Filler," or equal closed-cell polyethylene joint filler designed for use in cold joints, construction joints, or isolation joints wider than 1/4 inch (6 mm).

1. Size required for joint design.

F. Mineral Wool Batt Insulation – Owens Corning Thermafiber Safing or equal , 4.0 pcf, unfaced mineral fiber batts used as forming material for application of single-component spray-applied elastomeric sealant.

1. Size required for joint design.

G. Bond Breaker - Pressure-sensitive tape recommended by sealant manufacturer to suit application.

2.04. COLOR

A. Sealant Colors – From manufacturer's extended range of colors. Match to adjacent materials as directed by the Schedule of Joint Sealants at the end of this section.

PART 3 EXECUTION

3.01. EXAMINATION

A. Inspect all areas involved in work to establish extent of work, access, and need for protection of surrounding construction.

1. Verify that substrate surfaces and joint openings are ready to receive work.

2. Verify that joint backing and release tapes are compatible with sealant.

3.02. PREPARATION

A. Remove loose materials and foreign matter which impair adhesion of joint filler.

B. Clean joints and saw cuts by grinding, sandblasting, or wire brushing to expose a sound surface free of contamination and laitance. Prime joints.

C. Ensure structurally sound surfaces, dry, clean, free of dirt, moisture, loose particles, oil, grease, asphalt, tar, paint, wax, rust, waterproofing, curing and parting compounds, membrane materials, and other foreign matter.

D. Where the possibility of joint filler staining of adjacent areas or materials exists, mask joints prior to application.

1. Do not remove masking tape before joints have been tooled and initial cure of joint filler has taken place.

2. Work stained due to failure of proper masking precautions will not be accepted.

3.03. INSTALLATION

A. Back-Up Material

1. Install appropriate size backer rod, larger than joint where necessary according to manufacturer's recommendations.

2. Install polyethylene joint filler in joints wider than 1/4 inch (6 mm) to back-up material per manufacturer's recommendations.

3. Do not install epoxy joint filler over backer rod.

4. Install mineral wool backer material at locations where elastomeric spray applied sealants are scheduled to be used by pressure fitting snugly into joint space.

B. Bond Breaker - Install bond-breaker strip in joint to be sealed on top of back-up material to prevent adhesion of sealant to back-up material. Install per manufacturer's recommendations.

C. Sealant

1. Prepare sealants that require mixing. Follow manufacturer's recommended procedures, mixing thoroughly.

2. Mix only as much material as can be applied within manufacturer's recommended application time period.

3. Apply materials in accordance with manufacturer's recommendations. Take care to produce beads of proper width and depth, tool as recommended by manufacturer, and immediately remove surplus sealant.

4. Apply materials only within manufacturer's specified application life period. Discard sealant after application life is expired or if prescribed application period has elapsed.

3.04. CLEANING

A. Remove uncured sealant and joint filler with sealant manufacturer’s recommended solvent. Remove cured sealant and joint filler by razor, scraping, or mechanically.

B. Remove all debris related to application of sealants from job site in accordance with all applicable regulations for hazardous waste disposal.

3.05. SCHEDULE OF JOINT SEALANTS

Sealant Type	Locations for Application	Color	Comments
Multi-Component, Non- Sag Polyurethane (UL classified)	Metal or FRP door, window, or louver frames at masonry openings	Match frame color	Prime frame as recommended by sealant manufacturer for particular factory finish
Multi-Component, Non- Sag Polyurethane	Vertical control or movement joints in masonry	Match mortar color	
Two-Component, Self-Leveling Polyurethane Sealant	Control, movement, or perimeter joints in horizontal concrete	Match finished concrete color	
Silicone Sealant	Glass at metal	Clear	
Silicone Sealant Anti-Fungal	Plumbing fixtures abutting other materials	Match color of plumbing fixture	
Single-Component Acrylic Latex	Intersections of non-structural interior finish materials	White	Paint to match adjacent material
Polyurethane Foam Sealant	Gaps at windows, doors, louvers, and other openings	--	--

Sealant Type	Locations for Application	Color	Comments
Elastomeric Spray Sealant	Gaps at intersections between CMU wall and galvanized metal roof deck	Gray or red (manufacturer's standard)	Back with mineral wool batt insulation

END OF SECTION

SECTION 08110

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01. SECTION INCLUDES

A. All doors as specified shall be extra heavy duty, Grade III, 1-3/4-inch thick, Model 2, seamless design per SDI-100-91.

B. Non-rated and fire rated, steel doors and welded frames.

1.02. REFERENCES

ANSI-A250/SDI-100	Steel Door Institute Standard and Test Methods for Steel Doors and Frames
ANSI A117.1	Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People
ANSI A151.1	Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcing
ASTM A653	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process
ASTM C1363	Test Method for Thermal Performance of Building Assemblies by Means of a Hot-Box Apparatus
ASTM E2074	Methods of Fire Tests of Door Assemblies, Including Positive Pressure Testing of Side-Hinged and Pivoted Swinging Door Assemblies
Door Hardware Institute (DHI)	The Installation of Commercial Steel Doors and Steel Frames, Insulated Steel Doors in Wood Frames and Builder's Hardware
NFPA 80	Standard for Fire Doors and Windows
NFPA 252	Standard Methods of Fire Tests for Door Assemblies
SDI	Steel Door Institute Fact File
UL 10B	Underwriters Laboratory Standard for Fire Tests of Door Assemblies

1.03. SUBMITTALS

A. Shop Drawings - Indicate door and frame elevations, reinforcement, closure method, cut-outs for louvers, undercuts, and finish.

B. Manufacturer's Product Data - Indicate door and frame configurations, location of cut-outs for hardware reinforcement, anchor types and spacings.

1.04. QUALITY ASSURANCE

A. Conform to requirements of SDI-Fact File and ANSI A117.1.

1.05. QUALIFICATIONS

A. Manufacturer - Company specializing in manufacturing the products specified in this section with minimum five years' documented experience and current member of the Steel Door Institute (SDI).

1.06. REGULATORY REQUIREMENTS

A. Fire Rated Doors and Panel Construction – Conform to UL 10C. UL ratings for doors and frames to be as follows:

1. “A” label equals to 3-hour rating.

2. “B” label equals to 1-1/2-hour rating.

3. “C” label equals to 3/4-hour rating

B. Fire Rated Door Construction – Rate of rise of 450 degrees F across door thickness.

C. Installed Door and Frame Assembly – Conform to NFPA 80 for fire rated class as scheduled.

1.07. DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of this section. Store off ground in weathertight enclosure while affording proper air circulation.

B. Accept doors and frame on site in manufacturer’s packaging.

C. Break seal on-site to permit ventilation and inspect for damage.

1.08. FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings and instructed by the manufacturer.

1.09. COORDINATION

A. Coordinate the work with door opening construction, door frame, and door hardware installation, and glazing requirements.

PART 2 PRODUCTS

2.01. DOOR MANUFACTURERS

A. Amweld Building Products, Inc. - Product: 700 Series.

B. Ceco Door Division - Product: Imperial Series.

C. Curries Company - Product: Curries 707.

D. The Steelcraft Mfg. Company - Product: "LW" Series.

2.02. DOORS AND PANELS

A. Doors and steel accessories to be galvanized material; commercial class weighing not less than 0.30 oz/psf per side. Zinc-applied as ductile coating to both sides, bonded tightly to base metal. Wipe Coat Galvanized Steel (WCGS) is not acceptable.

B. Reinforce, drill, and tap doors to receive mortised hinges, locks, latches, flush bolts, and concealed closers as required. Such preparations for door hardware shall be performed by the door manufacturer in the factory.

C. Doors and metal panels to be SDI Extra Heavy Duty, Grade III, Model 2, 1-3/4-inches thick (minimum); seamless design, stretcher leveled, no exposed joints or seams, and fully enclosed.

D. No field welding permitted on factory fabricated units.

2.03. DOOR AND PANEL CONSTRUCTION

A. Face - Steel sheet 16-gauge steel.

B. Core - Reinforced, stiffened, sound deadened and insulated with polyurethane or polystyrene core.

C. Core of door to resist vermin, mildew, or rot.

2.04. FRAMES

A. Frames – 14-gauge thick material for all doors.

B. Spreaders to be provided for all frames.

2.05. ACCESSORIES

A. Apply protective coating to concealed steel surfaces in contact with cementitious materials or dissimilar metals.

B. Silencers – Provide at all interior doors not equipped with weatherstripping – resilient rubber, fitted into drilled hole. Glynn Johnson No. 64 or equal.

1. Three single silencers for single doors.

2.06. FABRICATION

A. Fabricate doors with hardware reinforcement welded in place.

B. Close top and bottom edge of exterior doors with flush end closure. Seal joints watertight.

C. Fabricate frames as welded unit.

D. Anchors to be as recommended by manufacturer for use with masonry construction.

1. UL at labeled doors.

E. Use adjustable base anchors at jambs or mullions using appropriate anchor type.

F. Side jamb anchors at 2 feet 0 inches o.c. maximum.

G. Provide for full mortise hardware, reinforced, drilled, tapped for hinges, lock strikes and all other hardware at factory.

H. Attach fire rated label to each door frame unit indicated as labeled on Drawings.

I. Reinforce frames wider than 48 inches with roll formed steel channels fitted tightly into frame head, flush with top.

J. Provide mortar guard boxes as protection for mortise hardware cut-outs.

2.07. FINISH

A. Steel Sheet - Galvanized to ASTM A526; A60.

B. Primer – Baked-on rust-inhibitive type.

C. Factory Finish - Doors, panels and frames to be bonderized over galvanized surface, shop painted with baked-on rust-inhibitive primer. Finish coat in field per finish schedule and Section 09900, Painting.

D. Any damage to primed galvanized surfaces, after installation, to be cleaned and touched up with zinc-rich paint.

E. Do not paint over fire labels.

PART 3 EXECUTION

3.01. EXAMINATION

A. Ensure that opening sizes and tolerances are acceptable.

B. Do not fill thermally broken frames with grout.

3.02. INSTALLATION

A. Install doors and frames in accordance with SDI Fact File.

B. Install door louvers, plumb and level.

C. Coordinate installation of doors with installation of hardware specified in Section 08710, Door Hardware.

3.03. ERECTION TOLERANCES

A. Maximum Diagonal Distortion - 1/16-inch measured with straight edge, corner to corner.

3.04. ADJUSTING

A. Adjust door for smooth and balanced movement.

END OF SECTION

SECTION 08119

STAINLESS STEEL DOORS AND FRAMES

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.

1.02. SUMMARY

A. Section Includes:

1. Stainless steel doors and frames.

1.03. COORDINATION

A. Coordinate anchorage installation for stainless steel frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.04. SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.

2. Details of doors, including vertical and horizontal edge details and metal thicknesses.

3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.

4. Locations of reinforcement and preparations for hardware.

5. Details of each different wall opening condition.

6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.

7. Details of anchorages, joints, field splices, and connections.

8. Details of accessories.

9. Details of moldings, removable stops, and glazing.

C. Samples:

1. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.

2. Doors: Show vertical-edge, top, and bottom construction; core construction and hinge and other applied hardware reinforcement.

3. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.

D. Product Schedule: For stainless steel doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

E. Field quality control reports.

1.05. DELIVERY, STORAGE, AND HANDLING

A. Deliver stainless steel doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use non vented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store stainless steel doors and frames under cover at Project site with head up. Place units on minimum 4-inch- high wood blocking.

D. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 PRODUCTS

2.01. MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ceco Door; AADG, Inc.; ASSA ABLOY.

2. Curries, AADG, Inc.; ASSA ABLOY Group.

3. Stainless Doors, Inc.

4. Or equal

2.02. FRAMES

A. Construct stainless steel door and frame assemblies to comply with NAAMM-HMMA 866 for the application indicated, including materials, fabrication methods, hardware reinforcement, tolerances, and clearances, and as specified. Comply with SDI ANSI/A250.4, for Physical Performance Level A.

B. Doors and Frames for Highly Corrosive Environments:

1. Stainless Steel Doors:

a. Type: As indicated in the Door Schedule.

b. Thickness: 1-3/4 inches.

c. Face Sheets: Type 316 stainless steel sheet, minimum thickness 0.062 inch.

d. Edge Construction: Continuously welded with no visible seam.

e. Top and Bottom Edges: Closed with continuous stainless-steel channels with minimum thickness of 0.062 inch, welded to face sheets.

1) Provide flush top and bottom closures for exterior doors, with weep holes at bottom edge.

f. Core Construction: Polyurethane laminated to face sheets.

2. Stainless Steel Frames:

a. Materials: Type 316 stainless steel sheet.

b. Door Frames for Openings 48 Inches Wide or Less: Fabricate from stainless steel sheet, minimum thickness 0.078 inch.

c. Door Frames for Openings More Than 48 Inches Wide: Fabricate from stainless steel sheet, minimum thickness 0.0780.109 inch.

d. Construction: Knocked down.

3. Hardware Reinforcement: Stainless steel sheet.

4. Finish: ASTM A480/A480M No. 6, Dull Satin.

2.03. MATERIALS

A. Stainless Steel Sheet: ASTM A240/A240M, austenitic stainless-steel Type 316.

B. Steel Sheet: ASTM A1008/A1008M or ASTM A1011/A1011M, commercial steel, Type B.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, commercial steel, Type B; with minimum G60 metallic coating.

D. Foam-Plastic Insulation: Manufacturer's standard polystyrene board insulation with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84. Enclose insulation completely within door.

E. Mineral-Fiber Insulation: Insulation made of rock-wool fibers, slag-wool fibers, or glass fibers.

F. Inserts, Bolts, and Anchor Fasteners:

1. Stainless steel components complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2 for bolts and nuts.

2. Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.04. STAINLESS STEEL PANELS

A. Stainless Steel Panels: Same construction, materials, and finish as specified for adjoining stainless steel doors.

2.05. FRAME ANCHORS

A. Provide anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.

B. Post installed Expansion Anchor: Minimum 3/8-inch diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

C. Number and Spacing:

1. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c.

D. Material:

1. Stainless steel sheet. Same type as door face.

2.06. FABRICATION

A. Stainless Steel Door Fabrication: Provide doors rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal.

1. Tolerances: Fabricate doors to tolerances indicated in NAAMM-HMMA 866.

2. Stops and Moldings: Factory cut openings in doors. Provide minimum 0.038-inch thick, stainless-steel stops and moldings around glazed lites. Form corners of stops and moldings with butted or mitered hairline joints.

a. Glazed Lites: Provide fixed stops and moldings welded on secure side of door.

b. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

B. Stainless Steel Frame Fabrication: Provide stainless steel frames rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal.

1. Tolerances: Fabricate frames to tolerances indicated in NAAMM-HMMA 866.

2. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

3. Borrowed-Lite Frames: Fabricate from 0.078-inch thick, stainless-steel sheet.

4. Transom Frames: Fabricate from stainless steel sheet of same thickness as adjacent door frame.

5. Provide countersunk, flat-, or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

6. Door Silencers: Except on weather-stripped and gasketed frames, drill stops to receive door silencers as follows. Provide plastic plugs to keep holes clear during construction.

   a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.

   b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

7. Stops and Moldings: Provide stops and moldings formed integrally with stainless steel frames around glazed lites minimum 5/8 inch high unless otherwise indicated. Form corners of stops and moldings with butted or mitered hairline joints.

   a. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

C. Hardware Preparation: Factory prepare stainless steel doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule, and templates.

1. Reinforce doors to receive non-templated mortised and surface-mounted door hardware.

2. Comply with ANSI/BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

2.07. FINISHES

A. Stainless Steel Finishes: Remove tool and die marks and stretch lines, or blend into finish. Grind and polish surfaces to produce uniform finish, free of cross scratches. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

B. Grain Direction: For finishes exhibiting grain, run grain vertically on door faces and frame jambs.

2.08. ACCESSORIES

A. Glazing: Comply with requirements in Section 08800 "Glazing."

B. Grout: Comply with ASTM C476, with a slump of not more than 4 inches as measured according to ASTM C143/C143M.

C. Mineral-Fiber Insulation: Insulation made of rock-wool fibers, slag-wool fibers, or glass fibers.

PART 3 EXECUTION

3.01. PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation and with installation spreaders in place, adjust and securely brace stainless steel door frames for squareness, alignment, twist, and plumb to the following tolerances:

1. Squareness: Plus, or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb, and perpendicular to frame head.

2. Alignment: Plus, or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.

3. Twist: Plus, or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.

4. Plumbness: Plus, or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive non-templated mortised and surface-mounted door hardware.

3.02. INSTALLATION

A. Install stainless steel doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with approved Shop Drawings and with manufacturer's written instructions.

B. Stainless Steel Frames:

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, without damage to completed Work.

a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.

b. Install frames with removable glazing stops located on secure side of opening.

2. Fire-Rated Openings: Install frames according to NFPA 80.

3. Floor Anchors: Secure with post-installed expansion anchors.

a. Floor anchors may be set with power-actuated fasteners instead of post-installed expansion anchors if so indicated and approved on Shop Drawings.

4. Solidly pack mineral-fiber insulation inside frames.

5. In-Place Concrete or Masonry Construction: Secure frames in place with post-installed expansion anchors.

6. Installation Tolerances: Adjust stainless steel frames for squareness, alignment, twist, and plumb to the following tolerances:

   a. Squareness: Plus, or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb, and perpendicular to frame head.

   b. Alignment: Plus, or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.

   c. Twist: Plus, or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.

   d. Plumbness: Plus, or minus 1/16 inch, measured at jambs at floor.

C. Stainless Steel Doors: Fit and adjust stainless steel doors accurately in frames within clearances specified below:

   1. Non-Fire-Rated Doors: Comply with NAAMM-HMMA 841 and NAAMM-HMMA 866.

D. Glazing: Install glazing in transoms and borrowed lites to comply with installation requirements in Section 08800 "Glazing."

3.03. FIELD QUALITY CONTROL

A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.04. ADJUSTING AND CLEANING

A. Clean grout and other bonding material off stainless steel doors and frames immediately after installation.

B. Stainless Steel Touchup: Immediately after erection, smooth any scratched or damaged areas of stainless steel; polish to match undamaged finish.

END OF SECTION

SECTION 08413

ALUMINUM-FRAMED ENTRANCES AND STOREFRONT

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.

1.02. SUMMARY

A. This Section covers Aluminum Storefront Systems, including perimeter trims, stools, accessories, shims and anchors, and perimeter sealing of storefront units.

B. Basis of Design: Kawneer Aluminum Storefront Systems:

1. Trifab® 451UT Framing System:

a. 2" x 4-1/2" (50.8 mm x 114.3 mm) nominal dimension.

b. Thermal.

c. Center Plane.

d. Screw Spline Fabrication.

1.03. DEFINITIONS

A. For fenestration industry standard terminology and definitions, refer to the Fenestration & Glazing Industry Alliance Glossary AAMA AG-13.

1.04. PERFORMANCE REQUIREMENTS

A. General Performance:

1. Product to comply with the specified performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction, as determined by testing of aluminum storefront systems representing those indicated for this project.

2. Aluminum storefront systems 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.

3. Failure includes any of these events:

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:

1. Design aluminum storefront systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Wind Loads:

1. The storefront system shall include anchorage that is capable of withstanding the following wind load design pressures:

a. Inward: (_____) psf

b. Outward: (_____) psf

2. The design pressures are based on the Building Code of New York State.

D. Air Leakage:

1. The test specimen shall be tested in accordance with ASTM E 283.

2. With interior seal, air leakage rate shall not exceed 0.06 cfm/ft2 (0.3 l/s · m2) at a static air pressure differential of 6.2 psf.

3. Without interior seal, air leakage rate shall not exceed 0.06 cfm/ft2 (0.3 l/s · m2) at a static air pressure differential of 1.6 psf.

4. CSA A440 Fixed Rating.

E. Water Resistance:

1. The test specimen shall be tested in accordance with ASTM E 331.

2. There shall be no leakage at a minimum static air pressure differential of 10 psf (479 Pa) as defined in AAMA 501.

F. Uniform Load:

1. A static air design load of 30 psf shall be applied in the positive and negative direction in accordance with ASTM E 330.

2. There shall be no deflection in excess of L/175 of the span of any framing member.

3. At a structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur.

G. Seismic:

1. When tested to AAMA 501.4, system must meet design displacement (elastic) of 0.010 x the story height and ultimate displacement (inelastic) of 1.5 x the design displacement.

H. Thermal Movements:

1. Allow for thermal movements resulting from the following:

a. 0°F to 180°F maximum change (range) in ambient and surface temperatures

b. 75°F test interior ambient air temperature

2. Test performance shows 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 for a minimum 3 cycles.

I. Thermal Transmittance (U-factor):

1. Thermal transmittance test results are based upon 1" (1/2" warm edge spacer and argon fill gas, 1/4").

2. When tested to AAMA Specification 1503, the thermal transmittance (U-factor) shall not be more than: .32.

J. Condensation Resistance Factor (CRF):

1. If using CRF: When tested to AAMA Specification 1503, the CRF shall not be less than 68 frame and 68 glass (low-e).

K. Sound Transmission Class (STC) and Outdoor-Indoor Transmission Class (OITC):

1. Sound transmission loss test results in accordance with AAMA 1801 are based upon 1" clear double laminated insulating glass with PVB interlayer.

2. Ratings shall not be less than STC 37 and OITC 30.

L. Environmental Product Declaration (EPD): Shall have a Type III Product-Specific EPD created from a Product Category Rule.

M. Material Ingredient Reporting:

1. Shall have a complete list of chemical ingredients to at least 100 ppm (0.01%) that covers 100% of the product.

2. Acceptable documentation includes:

a. Manufacturer's inventory with Chemical Abstract Service Registration Number (CASRN or CAS#):

1) Kawneer's Material Transparency Summary (MTS)

b. Cradle to Cradle certification; either document listed below is acceptable for this option:

1) Cradle to Cradle Certified™ with Material Health section Silver or higher

2) Silver Level or higher Material Health Certificate

c. Red List Free DECLARE label

1.05. SUBMITTALS

A. Product Data:

1. For each type of aluminum-framed storefront system indicated, include:

a. Construction details

b. Material descriptions

c. Dimensions of individual components and profiles

d. Hardware

e. Finishes

f. Installation instructions

2. Recycled Content:

a. Provide documentation that aluminum has a minimum of 50% mixed pre- and post-consumer recycled content.

b. Provide a sample document illustrating project-specific information that will be provided after product shipment.

c. After product has shipped, provide project-specific recycled content information:

1) Indicate recycled content, including the percentage of pre- and post-consumer recycled content per unit of product.

2) Indicate the relative dollar value of recycled content product to the total dollar value of product included in the project.

3) Indicate the location for recovery of recycled content.

4) Indicate the location of the manufacturing facility.

3. Environmental Product Declaration (EPD):

a. Include a Type III Product-Specific EPD created from a Product Category Rule.

4. Material Ingredient Reporting:

a. Include documentation for material reporting that has a complete list of chemical ingredients to at least 100 ppm (0.01%) that covers 100% of the product.

B. Shop Drawings:

1. Plans

2. Elevations

3. Sections

4. Details

5. Hardware

6. Attachments to other work

7. Operational clearances

8. Installation details

C. Samples for Initial Selection:

1. Provide samples for units with factory-applied color finishes.

2. Provide samples of hardware and accessories involving color selection.

D. Samples for Verification:

1. Provide a verification sample for aluminum-framed storefront system and required components.

E. Product Test Reports:

1. Provide test reports for each type of aluminum-framed storefront used in the project.

2. Test reports must be based on evaluation of comprehensive tests performed by a qualified preconstruction testing agency.

3. Test reports must indicate compliance with performance requirements.

F. Fabrication Sample:

1. Provide a fabrication sample of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12" (304.8 mm) lengths of full-size components and showing details of the following:

a. Joinery, including concealed welds

b. Anchorage

c. Expansion provisions

d. Glazing

e. Flashing and drainage

G. Entrance Door Hardware Schedule:

1. Schedule shall be prepared by or under the supervision of supplier.

2. Schedule shall detail fabrication and assembly of entrance door hardware, including procedures and diagrams.

3. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

1.06. QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer must have successfully installed the same or similar units required for the project and other projects of similar size and scope.

B. Manufacturer Qualifications:

1. Manufacturer must be capable of providing aluminum-framed storefront systems that meet or exceed performance the stated performance requirements.

2. Manufacturer must document this performance by the inclusion of test reports and calculations.

C. Source Limitations:

1. Obtain aluminum-framed storefront system through one source from a single manufacturer.

D. Product Options:

1. Drawings indicate size, profiles, and dimensional requirements of aluminum-framed storefront system and are based on the specific system indicated. Refer to Division 01 Product Requirements Section. Do not modify size and dimensional requirements.

2. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

E. Mockups:

1. Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

2. Build mockups for the type(s) of storefront elevation(s) indicated, in location(s) shown on drawings.

F. Structural-Sealant Glazing must comply with ASTM C 1401, “Guide for Structural Sealant Glazing” for design and installation of structural-sealant-glazed systems.

G. Structural-Sealant Joints: Design reviewed and approved by structural-sealant manufacturer.

1.07. PROJECT CONDITIONS

A. Field Measurements:

1. Verify actual dimensions of aluminum-framed storefront openings by field measurements before fabrication.

2. Indicate measurements on shop drawings.

1.08. WARRANTY

A. Submit manufacturer's standard warranty for owner's acceptance.

B. Warranty Period:

1. Two years from Date of Substantial Completion of the project provided however that in no event shall the Limited Warranty begin later than six months from date of shipment by manufacturer.

PART 2 PRODUCTS

2.01. MANUFACTURERS

A. Basis-of-Design Product:

1. Kawneer Company, Inc.

2. Trifab® 451UT Framing System:

a. 2" x 4-1/2" (50.8 mm x 114.3 mm) nominal dimension

b. Thermal

c. Center Plane

d. Screw Spline Fabrication

B. Substitutions:

1. Refer to Division 01 Substitutions Section for procedures and submission requirements.

2. Pre-Contract (Bidding Period) Substitutions:

a. Submit written requests ten (10) days prior to bid date.

3. Product Literature and Drawings:

a. Submit product literature and drawings modified to suit specific project requirements and job conditions.

4. Certificates:

a. Submit certificate(s) certifying that the substitute manufacturer (1) attests to adherence to specification requirements for storefront system performance criteria, and (2) has been engaged in the design, manufacture, and fabrication of aluminum storefronts for a period of not less than ten (10) years. (Company Name)

5. Test Reports:

a. Submit test reports verifying compliance with each test requirement required by the project.

6. Samples:

    a. Provide samples of typical product sections and finish samples in manufacturer's standard sizes.

C. Substitution Acceptance:

1. Acceptance will be in written form, either as an addendum or modification.

2. Acceptance will be documented by a formal change order signed by the owner and contractor.

2.02. MATERIALS

A. Aluminum Extrusions:

1. Alloy and temper recommended by aluminum storefront manufacturer for strength, corrosion resistance, and application of required finish

2. Not less than 0.070" (1.8 mm) wall thickness at any location for the main frame

3. Complying with ASTM B221: 6063-T6 alloy and temper

4. Recycled Content:

    a. Shall have a minimum of 50% mixed pre- and post-consumer recycled content.

    b. Indicate recycled content, including the percentage of pre- and post-consumer recycled content per unit of product.

    c. Indicate the relative dollar value of recycled content product to the total dollar value of product included in the project.

    d. Indicate the location for recovery of recycled content.

    e. Indicate the location of the manufacturing facility.

B. Fasteners:

1. Aluminum, nonmagnetic stainless steel or other materials must be non-corrosive and compatible with aluminum members, trim hardware, anchors, and other components.

C. Anchors, Clips, and Accessories:

1. Anchors, clips, and accessories shall provide sufficient strength to withstand the design pressure indicated.

D. Reinforcing Members:

1. Reinforcing members must provide sufficient strength to withstand the design pressure indicated.

E. Sealant:

1. For sealants required within fabricated storefront system, provide permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.

F. Tolerances:

1. References to tolerances for wall thickness and other cross-sectional dimensions of storefront members are nominal and in compliance with AA Aluminum Standards and Data.

G. Red List Free:

1. All parts and materials comply with the Living Building Challenge/DECLARE Red List and the Cradle-to-Cradle (C2C) Banned List:

a. PVC-free

b. Neoprene-free

2. Product does not contain PVC or Neoprene.

2.03. STOREFRONT FRAMING SYSTEM

A. Thermal Barrier:

1. Kawneer DUAL Isolock® Thermal Break with two (2) 1/4" (6.4 mm) separations consisting of a two-part chemically curing, high-density polyurethane, which is mechanically and adhesively joined to aluminum storefront sections.

2. Thermal break shall be designed in accordance with AAMA TIR-A8 and tested in accordance with AAMA 505.

B. Brackets and Reinforcements:

1. Manufacturer's standard high-strength aluminum with non-staining, non-ferrous shims for aligning system components.

C. Fasteners and Accessories:

1. Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories must be compatible with adjacent materials.

2. Where exposed, fasteners and accessories shall be stainless steel.

D. Perimeter Anchors:

1. When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.

E. Packing, Shipping, Handling, and Unloading:

1. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

F. Storage and Protection:

1. Store materials so that they are protected from exposure to harmful weather conditions.

2. Handle material and components to avoid damage.

3. Protect material against damage from elements, construction activities, and other hazards before, during, and after installation.

2.04. GLAZING SYSTEMS

A. Glazing to meet requirements in Section 08800 - Glazing.

B. Glazing Gaskets:

1. Manufacturer's standard compression types

2. Replaceable, extruded EPDM rubber

C. Spacers and Setting Blocks:

1. Manufacturer's standard elastomeric type

D. Bond-Breaker Tape:

1. Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

E. Glazing sealants as recommended by manufacturer for joint type, and as follows:

1. Weatherseal sealant:

a. ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O.

b. Single-component neutral-curing formulation that is compatible with the structural sealant and other system components with which it comes in contact.

c. Recommended by structural-sealant, weatherseal-sealant, and aluminum-framed-system manufacturers for this use.

d. Color: Matching structural sealant.

2.05. ENTRANCE DOOR SYSTEMS

A. Refer to Entrance Doors as specified in Section 08413 - Aluminum-Framed Entrances and Storefronts Section.

B. Refer to Entrance Door Hardware as specified in Section 08710 - Door Hardware.

2.06. ACCESSORY MATERIALS

A. Joint Sealants:

1. For installation at perimeter of aluminum-framed systems, as specified in Section 07900 - Joint Sealants.

B. Bituminous Paint:

1. Cold-applied asphalt-mastic paint.

2. Complies with SSPC-Paint 12 requirements except containing no asbestos.

3. Formulated for 30-mil (0.762 mm) thickness per coat.

2.07. FABRICATION

A. Fabricate framing member components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.

2. Accurately fitted joints that are flush, hairline, and weatherproof.

3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.

4. Physical and thermal isolation of glazing from framing members.

5. Accommodations for thermal and mechanical movements of glazing and framing that maintain required glazing edge clearances.

6. Provisions for field replacement of glazing.

7. Fasteners, anchors, and connection devices that are concealed from view to the greatest extent possible.

B. Mechanically Glazed Framing Members:

1. Fabricate for flush glazing without projecting stops.

C. Structural-Sealant-Glazed Framing Members:

1. Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.

D. Storefront Framing:

1. Fabricate components for assembly using manufacturer’s standard installation instructions.

E. After fabrication, clearly mark components to identify their locations in project according to shop drawings.

2.08. ALUMINUM FINISHES

A. Finish designations that are prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Factory Finishing:

1. Kawneer Permanodic® AA-M10C21A44, Architectural Class I Color Anodic Coating Color Medium Bronze.

PART 3 EXECUTION

3.01. EXAMINATION

A. With installer present, examine openings, substrates, structural support, anchorage, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work:

1. Verify rough opening dimensions.

2. Verify levelness of sill plate.

3. Verify operational clearances.

4. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components for proper water management.

5. Masonry Surfaces:

a. Masonry surfaces must be visibly dry and free of excess mortar, sand, and other construction debris.

6. Wood Frame Walls:

a. Wood frame walls must be dry, clean, sound, well nailed, free of voids, and without offsets at joints.

b. Ensure that nail heads are driven flush with surfaces in opening and within 3" (76.2 mm) of opening.

7. Metal Surfaces:

a. Metal surfaces must be dry and clean (free of grease, oil, dirt, rust, corrosion, and welding slag).

b. Ensure that metal surfaces are without sharp edges or offsets at joints.

B. Proceed with installation only after correcting unsatisfactory conditions.

3.02. INSTALLATION

A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing aluminum-framed storefront system, accessories, and other components.

B. Install aluminum-framed storefront system so that components:

1. Are level, plumb, square, and true to line

2. Are without distortion and do not impede thermal movement

3. Are anchored securely in place to structural support

4. Are in proper relation to wall flashing and other adjacent construction

C. Set sill members in bed of sealant or with gaskets, as indicated, for weather-tight construction.

D. Install aluminum-framed storefront system and components to drain condensation, water penetrating joints, and moisture migrating within aluminum-framed storefront system to the exterior.

E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.03. FIELD QUALITY CONTROL

A. Field Tests:

1. Architect shall select storefront units to be tested as soon as a representative portion of the project has been installed, glazed, perimeter caulked and cured.

2. Conduct tests for air infiltration and water penetration with manufacturer’s representative present.

3. Tests that do not meet the specified performance requirements and units that have deficiencies shall be corrected as part of the contract amount.

4. Testing shall be performed per AAMA 503 by a qualified independent testing agency. Refer to Testing Section for payment of testing and testing requirements.

5. Air Infiltration Tests:

a. Conduct tests in accordance with ASTM E 783.

b. Allowable air infiltration shall not exceed 1.5 times the amount indicated in the performance requirements or 0.09 cfm/ft2, whichever is greater.

6. Water Infiltration Tests:

a. Conduct tests in accordance with ASTM E 1105.

b. 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 6.2 psf (300 Pa).

B. Manufacturer's Field Services:

1. Upon owner’s written request, provide periodic site visit by manufacturer’s field service representative.

3.04. ADJUSTING, CLEANING, AND PROTECTION

A. Adjusting: Not applicable.

B. Protection:

1. Protect installed product’s finish surfaces from damage during construction.

C. Cleaning:

1. Clean glass immediately after installation.

    a. Comply with glass manufacturer's written recommendations for final cleaning and maintenance.

    b. Remove non-permanent labels and clean surfaces.

2. Clean aluminum surfaces.

3. Avoid damaging protective coatings and finishes.

4. Remove excess sealants, glazing materials, dirt, and other substances.

5. Repair or replace damaged installed products.

6. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during the construction period.

7. Remove construction debris from project site and legally dispose of debris.

END OF SECTION

SECTION 08450

INSULATED TRANSLUCENT SKYLIGHTS

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Furnish and install pre-engineered, factory prefabricated skylight units with light transmission, insulation, and chemical resistance characteristics as listed herein. Complete with aluminum framing, flashings, fasteners, trim and accessories to allow the installation of the insulated translucent panels as weathertight, wind load resistant, and removable systems, in accordance with the Contract Documents

1.02. REFERENCES

AAMA 2605	Voluntary Specifications, Performance Requirements, and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels
ASTM C297	Standard Test Method for Flatwise Tensile Strength of Sandwich Constructions
ASTM C518	Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C1199	Standard Test Method for Measuring the Steady-State Thermal Transmittance of Fenestration Systems Using Hot Box Methods
ASTM D635	Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
ASTM D1037	Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials
ASTM D2244	Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E283	Standard Test Method for Determining Rate of Air Leakage Through “Exterior Windows, Curtain Walls, and Doors Under Specified Pressure
ASTM E330	Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
UL 723	Test for Surface Burning Characteristics of Building Materials

1.03. PERFORMANCE REQUIREMENTS

A. Thermal Performance

1. 4-inch Roof Panels - “U” value of 0.08 or less as measured by ASTM C518 or ASTM C1199.

B. Light Transmission

1. 4-inch Roof Panels - 8 percent.

C. Structural Performance – Assembly as a whole shall withstand wind and other structural loads as specified in the structural design requirements on the structural drawings (see Drawing S001).

1. Panels shall meet the requirements of 1609.5.1 of 780 CMR for protection of openings in windborne debris regions, which references the Large Missile Test of ASTM E1996.

2. Configuration of both roof and wall panels shall meet all relevant performance requirements listed herein. When requested, include structural analysis data signed and sealed by the qualified professional engineer (currently licensed to practice in the State of New York) responsible for their preparation. Panel system shall have less than 0.01 cfm/sf air leakage by ASTM E283 at 6.24 psf (50 mph) and no water penetration by ASTM E331 at 15 psf, and structural testing by ASTM E330.

Provide system capable of handling the loads identified on the Structural Design Criteria Table on the Contract Drawings.

D. Insulated translucent roof panels (skylights) shall be attached in such a manner that they are removable as a unit from roof curb without compromising roof weathertightness. Panel manufacturer shall design and incorporate supporting structure that meets the structural performance requirements of paragraph 1.04.C. Similar to the wall panels, removal in such a way that requires reinstallation of perimeter sealants or fasteners shall not be considered damage to the panels. After removal, it shall be possible to reinstall the skylight unit as a weathertight system.

E. Interior Face Sheet Flame Spread and Smoke Developed – Flame spread rating of no greater than 25 and smoke developed of no greater than 250 when tested per ASTM E84.

F. Interior Face Sheet Burn Rate – No greater than 1 inch per minute when tested per ASTM D635.

G. Exterior Face Sheet Weathering – Darkening or change of color shall not exceed more than 4.0 Delta E units after five years of outdoor South Florida weathering at either 5 degrees or 45 degrees facing south, per ASTM D2244.

H. Adhesive Tensile Strength – Not less than 750 psi per ASTM C297 after accelerated aging per ASTM D1037.

1.04. SUBMITTALS

A. Provide in accordance with Section 01300, Submittals, and as supplemented herein. Submittals shall include, but not be limited to, the following:

1. Manufacturer's Certification – Letter from assembly manufacturer stating the thermal performance and light transmission values achieved by the assembly, and the insulated translucent panel assembly meets the performance requirements of this section.

2. Test Reports – The manufacturer shall submit certified test reports made by an independent testing organization. These reports shall verify that the panel system will meet all performance requirements of this specification. Previously completed test reports will be acceptable if they are for the current manufacturer and are indicative of the products to be used on this project. Test reports required are:

a. ASTM C297 after aging by ASTM D1037

b. ASTM D635

c. ASTM D2244

d. ASTM E84

e. ASTM C518 or C1199

3. Shop Drawings – Showing sizes and configurations of panels, layout of internal and external framing elements, profiles of all components used in the assembly, locations and types of fasteners, and wind loads for which the assembly was designed. Sealed by a Professional Engineer licensed and with current registration to practice in New York.

   a. Submit project-specific details for anchorage and weatherseal, including, but not limited to:

      1) Perimeter conditions, including eave, rake and ridge. Conditions at structural supports.

4. Samples – A representative corner of the insulated translucent panel assembly showing insulating, light-transmitting, and framing components. Sample to be submitted after Engineer has made colors choices from options within the manufacturer's standard line that meet specified performance requirements.

1.05. WARRANTY

A. Warrant insulated translucent panel assembly against failure of weathertightness, discoloration, or deterioration of surface finish for a period of five years following substantial completion. Any panels that fail within the warranty period shall be removed and replaced with new material at the Contractor's expense.

   1. Manufacturer's extended warranty to cover materials and workmanship for a period of 66 months.

PART 2 PRODUCTS

2.01. MANUFACTURERS AND SYSTEMS

Manufacturer	System
Kalwall Corporation, Manchester, NH	Kalwall 4-inch thickness panel (roof)

A. Or equal system when submitted under Section 01300, Submittals, and approved by the Engineer.

2.02. PANEL CONSTRUCTION

A. Configuration

   1. Thickness - Kalwall Standard wall panels; 4-inch thickness.

2. Grid Size – 12 inches by 24 inches; pattern to be centered on opening; long dimension to be oriented as shown on the Drawings.

3. Interior and exterior sections of frame members are to be separated by thermal break material, minimum thermal break of 1-inch.

B. Face Sheets

1. ICBO listed.

2. Thickness

a. 0.070 inches thick at exterior face.

b. 0.045 inches thick at interior face.

3. Fiberglass reinforced.

4. Color –Crystal inside and out.

C. Frame Finish - 70 Percent PVDF

1. Comply with requirements of AAMA 2605.

2. Color - Manufacturer's standard colors.

PART 3 EXAMINATION

3.01. EXAMINATION

A. Examine areas to receive translucent wall panel, with installer and manufacturer's representative present. Examine supporting structure, substrate, and other relevant components for dimensions, tolerances, material conditions, support, and other factors that may affect the performance of the installed system.

B. Notify the Engineer immediately of conditions that would adversely affect installation or subsequent utilization of wall panel system. Do not proceed with installation until unsatisfactory conditions are corrected and the Engineer has given permission to proceed.

3.02. PREPARATION

A. Ensure supports to receive translucent wall panel and skylight systems are clean, level, plumb, true and square.

B. Isolate aluminum from dissimilar metals or cement-containing materials by coating with bituminous paint or separating with a nonabsorbent isolator.

3.03. INSTALLATION

A. Install translucent wall panels system in strict accordance with approved shop drawings and the manufacturer's instructions.

B. Anchor wall panels system securely to supporting structure. Use attachment methods permitting adjustment for construction tolerances, irregularities, alignment, and expansion and contraction.

C. Install wall panel system including flashings, fasteners, hardware, sealants, and glazing materials required for a complete, weathertight installation.

3.04. CLEANING

A. Clean work per manufacturer's instructions and in accordance with Section 01700, Closeout and Record Documents.

3.05. PROTECTION

A. Protect work from continuing construction activity and per manufacturer's instructions.

END OF SECTION

SECTION 08710

DOOR HARDWARE

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Hardware for doors, including, but not limited to, thresholds, hinges, locksets, closers, and weatherstripping/gasketing.

1. All finish hardware necessary to complete the work, in sufficient quantities to meet the project requirements even though every such item is not specifically mentioned, including the correct number of screws of proper size, materials, and finish for each piece of hardware and all parts necessary to put all hardware in operating condition.

2. All labor, equipment and materials necessary to furnish and install all finish hardware complete in place, and as shown on the drawings, specified herein and approved by the Engineer.

3. The services of a Door and Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) certification level or above.

a. AHC consultant shall review and certify submittals prior to submission to Engineer for review.

b. AHC consultant shall provide (minimum) two hours of training with client to review hardware operation, maintenance and adjustment procedures prior to final closeout of project.

4. Master keyed cylinders used for entrance doors.

1.02. COORDINATION

A. The Contractor will be required to coordinate the related work of other sections with the work of this section and be responsible for the timely and expeditious performance of same.

B. Required coordination includes, but is not limited to, preparation requirements for doors and frames.

C. Coordinate internal hardware reinforcement of frames and doors.

D. Coordinate the compatibility of door preparations with suppliers of all the types of doors provided for the project.

E. Coordinate the compatibility of electronic locking hardware with associated elements, including exit device hardware and (where applicable) existing hardware.

1.03. REFERENCES

ANSI A117.1	Accessible and Usable Buildings and Facilities, Provisions of ADA Relating to Accessible Routes and Signage
NFPA 80	Fire Doors and Windows
NFPA 101	Code for Safety to Life from Fire in Buildings and Structures
SDI (Steel Door Institute)	Hardware Mounting
UL 10B	Fire Tests of Door Assemblies
UL 305	Panic Hardware
DHI (Door and Hardware Institute)	Architectural Hardware Consultant certification program; Sequence and Format for Hardware Schedule
ANSI/BHMA A156.2	Bored and Preassembled Locks and Latches
ANSI/BHMA A156.3	Exit Devices
ANSI/BHMA A156.13	Mortise Locks and Latches

1.04. SUBMITTALS

A. Submittal shall include:

1. Hardware Schedule – Submit in vertical format as illustrated by the DHI's "Sequence and Format for the Hardware Schedule." Hardware schedule shall clearly indicate the Engineer's hardware group and the manufacturer of each item proposed. A certified Architectural Hardware Consultant shall review the schedule prior to submission. The Architectural Hardware Consultant shall provide evidence of DHI certification and his or her review of the schedule for coordination and code compliance.

a. Review specified and proposed hardware for suitability and adaptability to details and surrounding conditions. Indicate unsuitable or incompatible items and proposed substitutions in hardware schedule.

b. Provide listing of manufacturer's template numbers for each item of hardware in hardware schedule.

c. Promptly furnish other Contractors and subcontractors with copies of final approved hardware schedule and templates.

2. Manufacturer's product data and specifications with selections and criteria highlighted in a fashion that is visible when printed copies are made.

B. Manufacturer's Installation Instructions - Indicate special procedures, perimeter conditions requiring special attention, and provide special tools of each size and type required for adjustment of hardware items. Turn over to Owner in good condition at project's end.

1.05. OPERATION AND MAINTENANCE DATA

A. Provide to Owner maintenance and adjustment data, templates, catalog pages for each product, special tools required for servicing hardware components that would only be available from hardware manufacturer, and name, address and phone number of a local representative for each manufacturer.

1. Provide hands-on training in maintenance, adjustment and use of special tools required and furnished by hardware supplier.

1.06. QUALITY ASSURANCE

A. Perform work in accordance with listed references in Article 1.04.

B. Hardware supplier is responsible for providing fire-rated hardware regardless of Contract Documents' depiction.

C. Qualifications of Manufacturers - Products used in the work of this section shall be produced by manufacturers regularly engaged in the manufacture of similar items and with a history of successful production acceptable to the Engineer.

1.07. REGULATORY REQUIREMENTS

A. Work shall conform to 2009 IBC.

B. Hardware supplier is responsible for providing proper hardware to meet UL requirements regardless of Contract Documents' depiction.

1.08. DELIVERY, STORAGE, AND HANDLING

A. Individual hardware items to be packaged and labeled. Package individual hardware items into labeled hardware sets.

B. Deliver keys to Owner by security shipment or certified mail direct from hardware supplier. Deliver "construction keying" masters that will void construction keys at substantial completion.

1. Maintain original master and each change key in secure location.

C. Protection – Use all means necessary to protect materials of this section before, during and after installation and to protect installed work and materials of all other trades.

D. Replacements – In the event of damage, immediately make all repairs and replacements necessary to the approval of the Engineer at no additional cost to the Owner.

PART 2 PRODUCTS

2.01. MANUFACTURERS

A. Burns Manufacturing, Erie, PA.

B. Corbin Russwin, Monroe, NC.

C. Dorma Architectural Hardware, Reamstown, PA.

D. Glynn-Johnson, Indianapolis, IN.

E. Hager Companies, St. Louis, MO.

F. Ives, Indianapolis, IN.

G. KABA-Ilco, Kaba Access Control, Winston Salem, NC

H. National Guard Products.

I. Pemko Mfg. Co., Memphis, TN.
J. Rockwood Mfg. Co., Rockwood, PA.

K. SARGENT Manufacturing Company, New Haven, CT

L. Schlage Allegion, Dublin, Ireland

M. The Stanley Works, New Britain, CT.

N. Or equal.

2.02. PRODUCTS SUPPLIED

A. Provide all hardware, fasteners, and accessories necessary to achieve fully functioning and smoothly operating doors in compliance with the codes cited in Part 1 of this section, and with the door schedule on the Drawings and the hardware group schedule in this section of the specifications.

B. Wherever technically feasible, all hardware of the same functional type shall be from a single manufacturer throughout the project, regardless of door material or other variables. For example, all door closers shall be from a single manufacturer. Locksets may be from a different manufacturer than door closers, but all locksets must be from a single manufacturer.

2.03. HARDWARE TYPES

A. Thresholds to be extruded aluminum with skid-resistant surface, meeting ADA requirements.

1. Thermal barrier threshold (5 inches wide); National Guard Products 8425 or Pemko 252x3AFG.

2. Saddle threshold (3 inches wide); National Guard Products 896A or Pemko 2005A. Use with exterior aluminum entry doors.

3. Saddle threshold (5 inches wide); use with interior doors where threshold is scheduled.

a. National Guard Products – 425

b. Pemko - 171A.

c. Or equal.

Thresholds and saddles are to be set in full bed of sealant, coped to frame, and secured with countersunk stainless steel screws and expansion shields.

B. Mortised Hinges - 4-1/2-inch by 4-1/2-inch for doors up to and including 38-inch wide doors; 5-inch by 5-inch for doors over 38 inches in width, up to 48 inches in width. Provide with non-removable pins on exterior reverse bevel doors. Use three hinges per leaf up to and including 7 feet 6 inches and one additional hinge for each additional 30 inches of door height. Maximum spacing of 30 inches between hinges on transom door panels.

1. Interior/exterior aluminum, stainless steel, or FRP doors; Hager BB1199-US32D, Stanley FBB199-US32D, or equal.

2. Interior steel doors with or without closers; Hager BB1199-US32D, Stanley FBB 179-US26D, or equal.

3. Interior steel doors heavy duty or high use, with or without closers; Hager BB1199-US32D, Stanley FBB199-US26D

C. Locksets, Latch Sets, and Exit Devices

1. Provide locksets, latch sets, and exit devices as shown by the table below. Locksets and latch sets to be Grade 1 per the applicable standards: ANSI/BHMA A156.2 or ANSI/BHMA A156.13.

   a. Provide stand-alone, battery powered, electronic access control system at all exterior building entrances and as scheduled. System shall provide the following features: minimum 2,000-user capacity per lock, 6-bit key override (with 6 keys supplied), capability to toggle lock on/off or pre-program timed re-lock, software control for PIN only, PROX only, or both (dual credential) entry.

   b. Provide manufacturer's specific software for door operator, complete with card enroller, hand held digital transfer device (DTD) or personal digital assistant (PDA), cables/connectors, and all hardware required to program/download door operator.

2. Acceptable Manufacturers

   a. Corbin Russwin Access 800 AC2

   b. KABA-Ilco Access Control E-Plex 5700

   c. Sargent Profile Series v G.1.5

   d. Schlage AD PRK Series.

   e. Or equal products by Dorma

   f. Or equal

3. Provide push bar fire exit hardware for labeled doors and panic hardware for non-labeled doors. Locks and latches to be mortise type. UL classify exit devices.
4. US32D finish.

5. For locking hardware, provide six-pin interchangeable core lock cylinders to accept cores compatible with Owner's existing master key system.

6. Lock trim shall be through bolted through the lock case to assure correct alignment and proper operation.

7. All locks, trim, and cylinders shall be from one manufacturer.

8. Aluminum (interior) vestibule doors shall be push-pull only using manufacturer's standard clear anodized devices.

D. Door closers to be sized per manufacturer's recommendations for width of door. Parallel arm mounting with heavy duty hold-open arms at exterior, out-swinging doors. Use non-metallic, corrosion-resistant covers. Provide without hold-open on rated doors.

	Corbin Russwin	Sargent	Dorma
Series	DC6210	351	7400

1. Include brackets for closers at outswinging exterior doors.

2. Devices shall be equipped with adjustable back check valves to prevent door or closer from striking adjacent wall or equipment.

E. Door Protection Plates - 0.050-inch stainless steel US32D plate, four sides beveled, 2 inches less than door width.

1. Stainless steel attachment hardware.

	Burns	Ives
Kickplate (10-inch high)	KP50	8400
Mop plate (4-inch high)	MP50	8400
Armor plate (42-inch high)	AP50	8400

F. Astragal Weatherstripping – Clear anodized aluminum retainer with silicone seal. Surface mounted center meeting (pair).

National Guard Products, Inc.	Pemko
137SA	303CS

G. Head and Jamb Weatherstripping – Clear anodized aluminum retainer with silicone seal.

National Guard Products, Inc.	Pemko
160SA	303SNS

H. Smoke and Draft Seals at Fire-Rated Doors

1. In-kerf seals at head and jamb equal to Smoke-Tech by CECO.

2. Where integral kerf is not provided, self-adhesive fire and smoke gasketing equal to S44 SiliconSeal by Pemko. Select color to match or blend with frame color.

I. Door Sweep – Stainless steel or aluminum retainer with neoprene seal: mounted on bottom of door in contact with threshold.

National Guard Products, Inc.	Pemko
198NA	321CN

J. Door Silencers - Resilient rubber, fitted into drilled hole on all non-rated interior doors; three at jambs of single doors and two at head for each leaf of double doors.

Ives	Rockwood
SR64	608

K. Door Stops - Locate for maximum swing, wall stop for masonry, floor stop for GWB or where wall mounting is not acceptable. Finish US26D (BHMA 626).

	Ives	Rockwood
Masonry Application (Wall)	WS401 CVX or WS401 CCV	402, 403
GWB (Floor Stop)	FS17	442

L. Flush Bolts – Where indicated on Drawings, provide extension flush bolts on inactive leaf of pairs of doors at top and bottom of door.

1. Top strike and dustproof foot strike.

2. Top bolts 12 inches long except at doors over 7 feet 6 inches high, where length provided shall permit operation from floor.

3. Top Bolts at High Hinged Transoms - Surface-mounted, chain operated, spring return.

M. Or equal.

2.04. FASTENERS

A. Fasteners shall be 316 stainless steel of proper types, sizes, and quantities. Provide all screws, special screws, bolts, special bolts, and other devices needed for proper application of hardware.

2.05. FINISHES

A. All hardware to be stainless steel unless noted otherwise.

B. Visible metal components are to be US32D wherever possible.

PART 3 EXECUTION

3.01. EXAMINATION

A. Ensure that doors and frames are ready to receive work and dimensions are as indicated on shop drawings and instructed by the manufacturer.

3.02. INSTALLATION

A. Install hardware in accordance with manufacturer’s instructions, Steel Door Institute Standards, NFPA 80 for fire doors, and NFPA 101 for exit doors.

B. Install hardware after doors and frames have been finished, including field painting/finishing if required.

C. Use templates provided by hardware manufacturer.

D. Hardware required for passage shall be mounted no higher than 48 inches above finished floor.

E. Door protection plates shall be installed on the push side of doors.

3.03. ADJUSTING

A. Adjust hardware for smooth operation.

B. All door closer parameters shall be properly adjusted, including closing speed, latching speed, backcheck, and delayed action.

3.04. ACCEPTANCE OF WORK

A. Following installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work.

B. Demonstrate that permanent keys operate respective locks then turn over to Owner as specified in this specification.

C. Demonstrate that door closers backcheck, delay, and close properly.

D. Correct, repair, and finish, as directed, errors in cutting and fitting or damage to adjoining work.

3.05. PROTECTION OF FINISHED WORK

A. Protect finished work from construction activity.

B. Do not permit adjacent work to damage hardware or finish.

END OF SECTION

SECTION 08800

GLAZING

PART 1 GENERAL

1.01. SUMMARY

A. Section Includes:

1. Glass products.

2. Insulating glass.

3. Glazing sealants.

4. Glazing tapes.

5. Miscellaneous glazing materials.

1.02. DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.

C. IBC: International Building Code.

D. Interspace: Space between lites of an insulating-glass unit.

1.03. COORDINATION

A. Coordinate glazing channel dimensions.

1. Provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

2. Achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

1.04. PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

2. Review temporary protection requirements for glazing during and after installation.

1.05. ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.

2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

3. Environmental Product Declaration (EPD): For each product.

C. Glass Samples: 12 inches square for each type of the following products:

1. Insulating glass.

D. Glazing Accessory Samples: For sealants and colored spacers, in 12-inch lengths.

E. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

F. Delegated Design Submittals: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.06. INFORMATIONAL SUBMITTALS

A. Product Test Reports: For fabricated glass and glazing sealants, for tests performed by a qualified testing agency.

1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

B. Preconstruction adhesion and compatibility test report.

C. Sample warranties.

1.07. QUALITY ASSURANCE

A. Fabricated-Glass Manufacturer Qualifications: A qualified manufacturer of fabricated glass units who is approved by primary glass manufacturer.

B. Glass Testing Agency Qualifications: A qualified independent testing agency accredited in accordance with the NFRC CAP Certification Agency Program.

C. Sealant Testing Agency Qualifications: An independent testing agency qualified in accordance with ASTM C1021 to conduct the testing indicated.

1.08. PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.

2. Use ASTM C1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.

3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.

4. Schedule enough time for testing and analyzing results to prevent delaying the Work.

5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

1.09. DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.10. FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

1.11. WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: 10 years from date of Substantial Completion.

C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01. MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Guardian Glass LLC; SunGuard Advanced Architectural Glass as processed by one of the following:

1. Guardian Glass LLC (Basis-of Design).

2. Pilkington North America.

3. Vitro.

4. Or otherwise listed with specific glass types in other Sections.

2.02. SOURCE LIMITATIONS

A. Source Limitations for Glass: Obtain float glass, laminated glass, and insulating glass from single source from single manufacturer.

B. Source Limitations for Low-E-Coated Glass: Where low-E-coated glass of primary glass manufacturer with a certified fabricator program is specified, obtain glass in fabricated units from manufacturer certified by coated-glass manufacturer.

C. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

2.03. PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems to withstand each applicable condition including the following:

1. Movements in all directions, temperature-related scenarios, and other load situations including design load cases and load case combinations without failure, which include the following:

a. Loss or glass breakage attributable to defective manufacture, fabrication, or installation.

b. Failure of sealants or gaskets to remain watertight and airtight, deterioration of glazing materials, or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer to design glazing.

C. Structural Performance: Glazing to withstand each applicable design load case and load case combination within limits and under conditions determined in accordance with the IBC and ASTM E1300, and as follows:

1. Design Wind Pressures: Determine design wind pressures applicable to Project in accordance with ASCE/SEI 7, based on heights above grade indicated on Drawings.

   a. Wind Design Data: As indicated on Drawings.

   b. Basic Wind Speed: 100 mph.

   c. Importance Factor: 1.0.

   d. Exposure Category: C.

   e. Retain "Design Snow Loads" Subparagraph below if sloped glazing is exposed to snow loads. The IBC requires that flat-roof snow load be indicated in the Construction Documents if ground snow load exceeds 10 lbf/sq. ft. (0.479 kN/sq. m).

2. Probability of Breakage for Sloped Glazing: For glass sloped more than 15 degrees from vertical, design glass for a probability of breakage not greater than 0.001.

3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length, whichever is less and keeps glazing retained in place with a suitable margin of safety under design conditions.

4. Thermal Loads: Design glazing to resist thermal stress breakage.

D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic glass lites, properties are based on units with lites of thickness indicated.

2. For laminated glass lites, properties are based on products of construction indicated.

3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.

4. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as Btu/sq. ft. x h x deg F.

5. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.

6. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

2.04. GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published instructions of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. NGA/GANA Publications: "Glazing Manual" and "Laminated Glazing Reference Manual."

2. FGIA/AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR-A7, "Sloped Glazing Guidelines."

3. FGIA/IGMA Publication for Sloped Glazing: IGMA TB-3001, "Guidelines for Sloped Glazing."

4. FGIA/IGMA Publication for Insulating Glass: IGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label indicates manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the IGCC.

D. Strength: Do not substitute relative to designations of annealed, heat-strengthened, and fully tempered glass.

2.05. GLASS PRODUCTS

A. Clear Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Guardian Glass LLC; see Schedule at end of Part 3 or comparable product by one of the following:

a. Guardian Glass LLC (Basis-of design product).

b. Pilkington North America.

c. Vitro Architectural Glass.

B. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion horizontally oriented after completion of field glazing unless Architect's advanced written approval is provided.

C. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion horizontally oriented after completion of field glazing unless Architect's advanced written approval is provided.

D. Low-E-Coated Vision Glass: ASTM C1376, coated by vacuum deposition (sputter-coating) process, and complying with other requirements specified.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Guardian Glass LLC; SunGuard SNR 50 on Clear or comparable product by one of the following:

a. Guardian Glass LLC (Basis-of design product).

b. Pilkington North America.

c. Vitro Architectural Glass.

2.06. INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.

1. Sealing System: Dual seal, with polyisobutylene primary and silicone secondary sealants.

2. Perimeter Spacer: Manufacturer's standard spacer material and construction.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Technoform.

2) Thermix; a brand of Ensinger USA.

3) Approved equal.

3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.07. GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.

3. Sealant to comply with testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

4. Sealant to comply with testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

5. Sealant to comply with testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions to not exceed 9 mcg/cu. m or 7 ppb, whichever is less.

6. Sealant to comply with testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

7. Sealant to comply with testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde to not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde to not exceed 9 mcg/cu.m.

8. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.

B. Neutral-Curing Silicone Glazing Sealant, Class 100/50: Complying with ASTM C920, Type S, Grade NS, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. GE Construction Sealants; Momentive Performance Materials Inc.

b. May National Associates, Inc.; a subsidiary of Sika Corporation.

c. Pecora Corporation.

d. Sika Corporation.

e. Dow Chemical Company.

f. Tremco Incorporated.

2. Applications:

C. Neutral-Curing Silicone Glazing Sealant, Class 50: Complying with ASTM C920, Type S, Grade NS, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Adfast.

b. GE Construction Sealants; Momentive Performance Materials Inc.

c. May National Associates, Inc.; a subsidiary of Sika Corporation.

d. Pecora Corporation.

e. Polymeric Systems, Inc.

f. Sika Corporation.

g. Dow Chemical Company.

h. Tremco Incorporated.

2. Applications.

D. Neutral-Curing Silicone Glazing Sealant, Class 25: Complying with ASTM C920, Type S, Grade NS, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Bostik, Inc.

b. GE Construction Sealants; Momentive Performance Materials Inc.

c. May National Associates, Inc.; a subsidiary of Sika Corporation.

d. Pecora Corporation.

e. Permathane/Acryl-R; ITW Polymers Sealants North America.

f. Polymeric Systems, Inc.

g. Sika Corporation.

h. Dow Chemical Company.

i. Tremco Incorporated.

2. Applications:

E. Acid-Curing Silicone Glazing Sealant, Class 25: Complying with ASTM C920, Type S, Grade NS, Use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Adfast.

b. Bostik, Inc.

c. GE Construction Sealants; Momentive Performance Materials Inc.

d. May National Associates, Inc.; a subsidiary of Sika Corporation.

e. Pecora Corporation.

f. Permathane/Acryl-R; ITW Polymers Sealants North America.

g. Polymeric Systems, Inc.

h. Sika Corporation.

i. Dow Chemical Company.

j. Tremco Incorporated.

2. Applications.

2.08. GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.

2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.

3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.

2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.09. MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks:

1. EPDM with Shore A durometer hardness of 85, plus or minus 5.

2. Type recommended in writing by sealant or glass manufacturer.

D. Spacers:

1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

2. Type recommended in writing by sealant or glass manufacturer.

E. Edge Blocks:

1. EPDM with Shore A durometer hardness per manufacturer's written instructions.

2. Type recommended in writing by sealant or glass manufacturer.

F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.10. FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

a. Temperature Change: 120 deg F.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 EXECUTION

3.01. EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.

2. Presence and functioning of weep systems.

3. Minimum required face and edge clearances.

4. Effective sealing between joints of glass-framing members.

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

3.02. PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.03. GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches.

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.

2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior, or interior as specified.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

3.04. TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.05. GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.06. SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.07. CLEANING AND PROTECTION

A. Immediately after installation, remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.08. INSULATING GLASS SCHEDULE

A. Low-E Coated, Insulating Glass Type Vision: Basis-of-Design Product: Guardian Glass LLC; SunGuard SNR 50 on Clear.

1. Conformance: ASTM E 2190.

2. Overall Unit Thickness: 1 inch.

3. Thickness of Each Glass Lite: 1/4 inch (6 mm).

4. Outboard Lite: Sputter-coated on clear float glass.

a. Coating on Surface No. 2: Guardian SunGuard SNR 50.

b. Heat Treatment: [Heat-strengthened, ASTM C 1048, Kind HS] OR [Tempered; ASTM C 1048, Kind FT; CPSC 16CFR-1201; ANSI Z 97.1].

5. Air Space: 12 mm (1/2 inch) wide, hermetically sealed, dehydrated air space.

6. Inboard Lite: Guardian Clear float glass.

a. Heat-Treatment: [None] [Heat-strengthened, ASTM C 1048, Kind HS] [Tempered; ASTM C 1048, Kind FT; CPSC 16CFR-1201; ANSI Z 97.1].

7. Glass Unit Performance Characteristics:

a. Visible Light Transmittance: 48 percent

b. Reflectance Outdoors: 26 percent

c. Solar Heat Gain Coefficient: 0.25

d. Winter U-Value Nighttime: 0.24

e. Summer U-Value Daytime: 0.21

8. Edge Seals: ASTM E 2188, with aluminum spacers, dual-sealed with a primary seal of polyisobutylene and a secondary seal of silicone sealant for glass-to-spacer seals.

9. Sealant: Approved by glass manufacturer.

B. Ceramic or Silicone Coated, Low-E Coated, Insulating Glass Type Spandrel: Basis-of-Design Product: Guardian Glass LLC; SunGuard SNR 50 on Clear with Medium Gray Spandrel.

1. Conformance: ASTM E 2190.

2. Overall Unit Thickness: 1 inch.

3. Thickness of Each Glass Lite: 1/4 inch (6 mm).

4. Outboard Lite: Sputter-coated on clear float glass.

    a. Coating on Surface No. 2: Guardian SunGuard SNR 50.

    b. Heat Treatment: [Heat-strengthened, ASTM C 1048, Kind HS] OR [Tempered; ASTM C 1048, Kind FT; CPSC 16CFR-1201; ANSI Z 97.1].

5. Air Space: 12 mm (1/2 inch) wide, hermetically sealed, dehydrated air space.

6. Inboard Lite: Guardian Clear float glass.

    a. Coating on Surface No. 4: Ceramic Spandrel Color as selected by Architect.

    b. Heat-Treatment: Tempered; ASTM C 1048, Kind FT; CPSC 16CFR-1201; ANSI Z 97.1.

7. Glass Unit Performance Characteristics:

    a. Visible Light Transmittance: 0 percent

    b. Reflectance Outdoors: 30 percent

    c. Solar Heat Gain Coefficient: 0.19

    d. Winter U-Value Nighttime: 0.24

    e. Summer U-Value Daytime: 0.21

8. Edge Seals: ASTM E 2188, with aluminum spacers, dual-sealed with a primary seal of polyisobutylene and a secondary seal of silicone sealant for glass-to-spacer seals.

9. Sealant: Approved by glass manufacturer.

END OF SECTION

SECTION 09216

NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.01. RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.

1.02. SUMMARY

A. This section includes steel framing members for the following applications:

1. Interior framing systems (e.g., supports for partition walls, suspended ceilings, furring, etc.).

2. Exterior framing systems (e.g., supports for parapet/ soffit on entry vestibule, etc.).

1.03. SUBMITTALS

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

PART 2 PRODUCTS

2.01. STEEL FRAMING, GENERAL

A. Framing Members, General - Comply with ASTM C754 for conditions indicated.

1. Steel Sheet Components - Comply with ASTM C645 requirements for metal, unless otherwise indicated.

2. Protective Coating - Coating with equivalent corrosion resistance of ASTM A653/A653M, G40, hot-dip galvanized, unless otherwise indicated.

2.02. STEEL FRAMING FOR FRAMED ASSEMBLIES

A. Steel Studs and Runners - ASTM C645.

1. Minimum Base Metal Thickness - 0.0312 inch.

2. Depth - As indicated on Drawings.

B. For slip joint at stud and top-track interface (head joint) that avoids axial loading of partition by overhead structure.

1. Deflection Track - Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

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

1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.

2) Steel Network Inc. (The); VertiClip SLD Series.

3) Superior Metal Trim; Superior Flex Track System (SFT).

4) Or equal.

C. Flat Strap and Backing Plate - Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base Metal Thickness - 0.0312 inch.

D. Cold-Rolled Channel Bridging - 0.0538-inch bare-steel thickness, with minimum 1/2-inch wide flanges.

1. Depth - 1-1/2 inches.

2. Clip Angle - Not less than 1-1/2 by 1-1/2 inches, 0.068-inch thick, galvanized steel.

2.03. SUSPENSION SYSTEMS

A. Wire Hangers - ASTM A641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

B. Grid Suspension System for Gypsum Board - ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Products - Subject to compliance with requirements, available products that may be incorporated into the work include, but are not limited to, the following:

a. Armstrong World Industries, Inc.; Drywall Grid Systems

b. Chicago Metallic Corporation; Drywall Grid System

c. USG Corporation; Drywall Suspension System

d. Or equal

2.04. AUXILIARY MATERIALS

A. General - Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing - Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 EXECUTION

3.01. EXAMINATION

A. Examine areas and substrates, with installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.

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

3.02. INSTALLATION, GENERAL

A. Installation Standard - ASTM C754, except comply with framing sizes and spacing indicated.

1. Gypsum Board Assemblies - Also comply with requirements in ASTM C840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.03. INSTALLING FRAMED ASSEMBLIES

A. Install studs so flanges within framing system point in same direction.

1. Space studs as follows:

a. Single-Layer Application - 24 inches o.c., unless otherwise indicated.

B. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints - Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.

2. Door Openings - Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

a. Install two studs at each jamb unless otherwise indicated.

b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.

c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

C. Furring Members

1. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

2. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner.

D. Installation Tolerance - Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.04. INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components according to manufacturer's installation instructions.

B. Grid Suspension Systems - Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

C. Installation Tolerances - Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

SECTION 09260

GYPSUM BOARD SYSTEMS

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Gypsum board panel products.

B. Metal stud wall framing.

C. Taped and sanded joint treatment and joint treatment products.

1.02. REFERENCES

ASTM C36	Gypsum Wallboard
ASTM C475	Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C514	Nails for the Application of Gypsum Wallboard
ASTM C630	Water Resistant Gypsum Backing Board
ASTM C636	Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM C645	Non-Structural Steel Framing Members
ASTM C840	Application and Finishing of Gypsum Board
ASTM C1186	Flat Non-Asbestos Fiber-Cement Sheets
ASTM E119	Fire Tests of Building Construction and Materials
GA-214	Gypsum Association Recommended Levels of Gypsum Board Finish
GA-216	Gypsum Association Application and Finishing of Gypsum Board

1.03. SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data - Provide data on gypsum board type, fasteners, joint tape, joint compounds, trim and accessories.

1.04. QUALIFICATIONS

A. Applicator - Company specializing in performing the work of this section with minimum five years' documented experience in heavy commercial or industrial work.

PART 2 PRODUCTS

2.01. MANUFACTURERS - GYPSUM BOARD SYSTEM

A. United States Gypsum Corporation.

B. National Gypsum Company.

C. Georgia-Pacific Product.

D. Substitutions

2.02. GYPSUM BOARD MATERIALS

A. Fire-Rated Gypsum Board - ASTM C36; fire resistive type, UL rated; 5/8-inch thick, maximum permissible length; ends square cut, tapered edges.

B. Moisture-Resistant Fire Rated Gypsum Board - ASTM C630; 5/8 inch thick, maximum permissible length; ends square cut, tapered edges.

2.03. ACCESSORIES

A. Anchorage to Substrate - Nails or screws of type and size to suit application in compliance with GA-216 and manufacturer's recommendations.

B. Corner Beads, L and J Trim, Casing Beads, Control Joints - Manufacturer’s standard/recommendations, galvanized steel.

C. Joint Materials - ASTM C475; reinforcing tape, and joint compound.

1. Joint compound used as finishing material and adhesive for laminated applications.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify that site conditions are ready to receive work and opening dimensions are as instructed by the manufacturer.

3.02. GYPSUM BOARD INSTALLATION

A. Install gypsum board in compliance with GA-216 and manufacturer’s instructions.

B. Erect boards in single layer perpendicular to framing members with ends and edges occurring over firm bearing.

C. Use screws when fastening gypsum board.

D. Treat cut edges and holes in moisture resistant gypsum board with sealant.

E. Place corner beads at external corners. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials.

3.03. JOINT TREATMENT

A. In compliance with GA-214 and manufacturer’s instructions.

1. Level 2 at diaphragms above suspended ceilings.

2. Level 5 at all walls and ceilings exposed to view.

B. Feather coats onto adjoining surfaces so that camber is maximum 1/32-inch.

3.04. TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness - 1/8 inch in 10 feet in any direction.

END OF SECTION

SECTION 09900

PAINTING

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Field preparation and painting of:

1. Surfaces and materials indicated to receive paint/coatings in the Room Finish Schedule, or Exterior Color and Finish Schedule on the architectural drawings.

2. Equipment, fabrications, and surfaces listed in Table A-2, Equipment Finish Schedule or where field preparation or painting is called for in the specification for that equipment or fabrication.

a. Any equipment, whether listed in Table A-2 or not, that is not provided by its manufacturer with surface preparation, prime coat, and finish coats suitable to protect the equipment for its service life in the environment where it is to be installed. If equipment manufacturer proposes their standard coating, they shall submit a certification as specified.

3. Pipes, fittings, valve bodies and other components of piping systems listed in Table A-3, Piping Color and Label Schedule.

a. In addition to all new piping, all existing interior piping to remain in buildings in which work is being performed shall be repainted and relabeled in accordance with the provisions listed herein.

4. All miscellaneous steel fabrications, steel stairs and structural steel. This includes galvanized steel where a paint/coating finish is called for in schedules, on Drawings, or in the specifications. Stainless steel is not to be coated except where specifically noted or scheduled.

5. Any equipment or fabrications where field preparation or painting is called for in the specification for that equipment or fabrication.

6. Any surface or object indicated as painted/coated in the Drawings.

B. Supply and installation of pipe labels per Table A-3, Piping Color and Label Schedule and Section 15076, Piping and Equipment Identification.

C. Work not to be painted/coated under this section includes:

1. Any surfaces not listed, specified, noted or scheduled to receive paint/coating as listed in paragraph 1.01.A.

2. Cast-in-place concrete surfaces scheduled, specified, or noted to receive other finishes specified in Sections 03350, Concrete Finishes.

3. Clay masonry or concrete masonry unless specifically scheduled or called out.

4. Factory finished interior or exterior equipment, furnishings or materials except as listed in paragraph 1.01.A.

5. Safety labels, equipment tags, UL, or other standards compliance certification labels, or other features required to be visible to meet codes or regulations, or to facilitate equipment operation.

1.02. REFERENCES

ASTM B117	Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM D522	Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings (Method A, Conical Mandrel)
ASTM D870	Standard Practice for Testing Water Resistance of Coatings Using Water Immersion
ASTM D1014	Standard Practice for Conducting Exterior Exposure Tests of Paints and Coatings on Metal Substrates
ASTM D1653	Moisture Vapor Transmission
ASTM D2794	Impact
ASTM D3363	Hardness
ASTM D4541	Adhesion (Type II Fixed Alignment Adhesion Tester)
ASTM D4541	Adhesion (Type V Self-Aligning Adhesion Tester)
ASTM D4585	Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation
ASTM D16	Standard Terminology for Paint-Related Coatings, Materials, and Applications
ASTM D4060	Abrasion Resistance (CS-17 Wheel, 1000 Grams Load)
ASTM D3359	Adhesion by Tape Test
ASTM G53	QUV Exposure (UVA-340 Bulbs, 4 Hours Light, 4 Hours Dark)
ASTM G85	Prohesion
NACE	NACE International (formerly “National Association of Corrosion Engineers”) – certification program
NSF International	ANSI/NSF Standard 61
SSPC-Volumes 1 and II	Steel Structures Painting Council - Steel Structures Painting Manual
SSPC-SP1	Solvent Cleaning
SSPC-SP2	Hand Tool Cleaning
SSPC-SP3	Power Tool Cleaning
SSPC-SP5	White Metal Blast Cleaning
SSPC-SP6	Commercial Blast Cleaning
SSPC-SP7	Brush-Off Blast Cleaning
SSPC-SP10	Near-White Metal Blast Cleaning
SSPC-SP11	Power Tool Cleaning to Bare Metal
SSPC-SP13 / NACE No. 6	Surface Preparation of Concrete
SSPC-SP16	Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals
N.S.F. (National Sanitation Foundation)	

1.03. DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this section.

1.04. SUBMITTALS

A. Painting experience record and qualifications of proposed subcontractor/Contractor. The subcontractor/Contractor shall have a minimum of five years' experience and provide references for at least three projects of similar size and type that have been successfully completed.

B. Submit a complete schedule of paint/coating systems and surface preparations.

1. List all interior and exterior surfaces and all major equipment to be painted.

2. The schedule is to reflect the approved manufacturer's recommendations. Schedule shall include certification that a qualified manufacturer's representative has reviewed and approved the schedule. The qualified manufacturer's representative shall hold current NACE certification as a Coating Inspector, Protective Coatings Specialist, or Materials Selection/Design Specialist.

3. As a minimum, schedule shall itemize each painted item or surface and shall contain the following information in tabular format:

a. Type of surface preparation (note whether shop or field preparation).

b. Paint or coating system (generic name).

c. Prime coat (product, number of coats, dry mil thickness per coat, square feet coverage per gallon).

d. Intermediate coat, if required (product, number of coats, dry mil thickness per coat, square feet coverage per gallon).

e. Finish coat (product, number of coats, color, dry mil thickness per coat, square feet coverage per gallon).

f. Painting/coating status at time of installation.

g. Remarks (any special treatment or application requirements, etc.)

4. The schedule shall follow the sample format attached to the end of this section. It shall also contain the name of the paint/coating manufacturer and name, address, and telephone number of the manufacturer's representative who will inspect the work. The schedule shall be in conformance with the criteria of Table A-1 and the schedules contained in the architectural drawings. Manufacturer's recommended dry mil thickness shall be incorporated into the schedule. Schedule shall be submitted to the Engineer as soon as possible following the award of Contract so that the approved schedule may be used to identify colors and to specify shop paint/coating systems for fabricated equipment.

5. Contractor shall provide a tabulation of equipment manufacturer's preparation and coating system with remarks specifying which equipment coatings meet the requirements specified herein and which equipment requires field painting.

6. Where applicable, submit a certification from the equipment manufacturer if they propose to utilize their standard coating system. Certification shall provide the following:

    a. Tabular comparison of the specified coating system and the manufacturer's proposed coating system, including, at a minimum; coating manufacturer, coating material, number of coats, thickness by coat, and as specified in the painting schedule.
    b. Statement that manufacturer has reviewed the Contract Documents and is providing a coating system for the environmental exposure and service of their equipment.

    c. Statement that coating system meets or exceeds requirements as specified in this specification section.

    d. Statement that application of manufacturer's coating system does not affect the manufacturer's equipment warranty.

    e. Statement that if manufacturer's coating system is determined to be defective or fails, manufacturer will investigate and provide the required materials, labor, and shipping to repair or recoat the equipment at no additional cost to the Owner.

C. Submit color chips for selection. Color names and/or numbers shall be identified according to the appropriate color chart published by the manufacturer.

PART 2 PRODUCTS

2.01. MANUFACTURERS

A. Provide paint, stain, varnish, coating, and other products identified in this Section by the manufacturers shown in Table A-1. The naming of a manufacturer for one paint/coating system in Table A-1 (example: M-3) is not to be construed as approval of that manufacturer for other systems. Listed manufacturers include:

1. Sherwin-Williams

2. PPG

3. Tnemec

4. Or approved equal

B. Equivalent materials of other manufacturers may be substituted only by approval of Engineer.

Requests for substitution shall include manufacturer's literature for each product giving the name, generic type, descriptive information, solids by volume, and coverage rate or recommended dry film thicknesses.

1. Requests for substitution shall also include a list of five projects where each product has been used and rendered satisfactory service; which list shall include the following information:

    a. Name and location of the project.

b. A contact (name and telephone number) at the project who is in a position to be aware of the performance of the proposed coatings; typically the maintenance director or superintendent of buildings and grounds.

c. Information about which coatings were used on which surfaces at the referenced project.

2. No request for substitution shall be considered that does not provide equal or better performance than the specified products. Provide manufacturer's certified test reports of characteristics relevant to the proposed product installation, showing that substitute product(s) equal or exceed performance of specified products as tested according to the standards listed below, or tests of equal relevance and severity:

a. ASTM D5894 – Corrosion Weathering (cycle testing).

b. ASTM D522 - Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings (Method A, Conical Mandrel).

c. ASTM D870 - Standard Practice for Testing Water Resistance of Coatings Using Water Immersion.

d. ASTM D1014 - Standard Practice for Conducting Exterior Exposure Tests of Paints and Coatings on Metal Substrates.

e. ASTM D4060 - Abrasion Resistance: CS17 wheel, 1000 cycles, 1 kg load.

f. ASTM D4541 - Abrasion Resistance.

g. ASTM D5894 – Adhesion.

h. ASTM D4585 – Humidity Resistance.

C. Products for each specified function and system shall be of a single manufacturer.

D. Where thinning is necessary, only the products of the particular manufacturer furnishing the paint/coating shall be used, and all such thinning shall be done in strict accordance with the manufacturer's instructions.

2.02. MATERIAL

A. For all coatings, refer to Table A-1, Coating System Schedule.

B. All materials which will be in contact with potable water shall be approved by the National Sanitation Foundation and appropriate state and local health departments. Contractor shall submit evidence of approval for all applicable materials.

C. All materials used on this project, whether shop applied by equipment manufacturer or field applied by Contractor, shall comply with all current federal, state and local Clean Air Act-related regulations. It shall be the responsibility of equipment manufacturers to comply with laws in effect at their painting/coating facilities. Where laws or regulations prohibit field applications of any scheduled paint /coating product, Contractor shall submit for Engineer's approval, an alternate product of similar performance characteristics which complies with those laws. If approved, those products shall be provided at no additional cost to the Owner.

PART 3 EXECUTION

3.01. EXAMINATION

A. Ensure that substrate conditions are ready to receive work as instructed by the product manufacturer and in accordance with the approved schedule of paint/coating systems and surface preparations.

B. Examine surfaces scheduled to be finished prior to commencement of work. Correct any condition that may potentially affect proper application.

3.02. SURFACE PREPARATION

A. Prepare surfaces in accordance with the direction and referenced standards shown in Table A-1.

B. If, for any reason, Contractor deems the surface preparation shown in Table A-1 to be inappropriate for a specific surface or location; Contractor to submit a proposed alternative preparation, in the form of a signed recommendation by the manufacturer's NACE-certified representative for Engineer's approval.

3.03. APPLICATION

A. Contractor shall be responsible for cleanliness of all painting/coating operations and use covers and masking tape to protect work. Contractor shall protect not only his own work, but also all adjacent work and materials by adequate covering with drop cloths.

B. Contractor shall maintain a daily epoxy coatings induction record (log) showing each epoxy coating mixing event in the format demonstrated at the end of this section. A signed copy of this log shall be turned over to the Engineer's field representative before the end of each working day during which epoxy coatings are mixed or applied.

C. Any unwanted coating shall be carefully removed without damage to finished coating or surface. If damage does occur, the entire surface adjacent to and including damaged area shall be recoated without visible lap marks.

D. Do not use plumbing fixtures or waste piping for mixing of paint/coatings or disposal of any refuse material. All waste shall be disposed of properly into a suitable receptacle located outside of building.

E. All coatings shall be applied without runs, sags, thin spots, or unacceptable marks. Coatings shall be applied at the rate specified to achieve minimum dry mil thickness required. Additional layers of coating shall be applied, if necessary, to obtain dry film thickness specified.

F. Application shall be by spraying where recommended by manufacturer. If material has thickened or must be diluted for application by spray gun, each coat shall be built up to the same film thickness achieved with undiluted brushed-on material. Where thinning is necessary, such thinning shall be done in strict accordance with manufacturer's instructions.

G. A minimum of 24 hours drying time shall elapse between application of any two layers of coating on a particular surface, unless otherwise recommended by coating manufacturer. Longer drying times may be required for abnormal conditions in concert with manufacturer's recommendations.

H. No coating whatsoever shall be accomplished in rainy or excessively damp weather when the relative humidity exceeds 85 percent, or when the general air temperature cannot be maintained at 50 degrees F (10 degrees C) or above throughout entire drying period.

I. Apply color coding to all new piping, in accordance with Piping Color and Label Schedule in Section 15076, Piping and Equipment Identification, and/or Engineer's instructions. Piping shall be painted solid colors unless otherwise specified.

3.04. FINISHING SHOP PRIMED EQUIPMENT

A. All fabricated steel work and equipment scheduled to be delivered to job site shop primed, and scheduled for field finish painting/coating, shall receive at factory at least one shop layer of approved prime paint/coating compatible to be applied in concert with paint system required by these Specifications. Surface preparation prior to shop painting shall be as scheduled in Table A-1. All shop primed items shall be properly packaged and stored until they are incorporated in work. Any primed surfaces that are damaged during handling, transportation, storage, or installation shall be cleaned, scraped, and patched before field painting/coating begins so that work shall be equal to original painting/coating at shop. Equipment or steel work that is to be assembled on the site shall likewise receive a minimum of one shop layer of paint/coating at factory. Paint and surface preparation used for shop coating shall be identified on equipment shop drawings submitted to Engineer.

B. Where exact identity of shop primer cannot be determined, or where primer differs from that specified, Contractor shall perform blast cleaning appropriate for service, followed by specified paint/coating system. In lieu of above, Contractor has the option of shipping bare metal to job site and performing appropriate blast cleaning, followed by field prime of specified material immediately thereafter.

3.05. FIELD QUALITY CONTROL

A. Prior to receiving a Certificate of Substantial Completion, Contractor shall arrange for manufacturer to inspect the application of his product and shall submit his report to Engineer identifying products used and verifying that said products were properly applied and that paint/coating systems were proper for the exposure and service. The manufacturer's representative shall also certify that all coats in each system are compatible with one another.

B. The Contractor shall follow a system of tinting successive paint/coating layers so that no two coats for a given surface are exactly the same color. Areas to receive black protective coatings shall be tick-marked with white or actually gaged as to thickness when finished.

3.06. SHOP PAINTING

A. Shop painting/coating of manufactured items (such as lockers, furnishings, and electrical and mechanical equipment) is not included in the scope of this work, unless specifically scheduled; as in the case of fabricated steel items (steel stairs, structural and miscellaneous steel), steel doors and frames). Manufactured items shall be finished as noted in the specification section related to that item.

(continued)

TABLE A-1

COATING SYSTEM SCHEDULE

Non-Submerged Concrete Walls and Ceilings – Interior

System C-1	Sherwin-Williams	PPG	Tnemec	Remarks
Surface Preparation	In accordance with ASTM D4258			Allow concrete to cure 28 days prior to beginning coating operations
Prime Coat	--	--	--	--
Intermediate Coat	Macropoxy 646 3.5-5.0 mils/coat	Amerlock 2/400	Series V69 3.0-5.0 mils/coat	--
Finish Coat	Macropoxy 646 3.5-5.0 mils/coat	Amerlock 2/400	Series V69 3.0-5.0 mils/coat	Total DFT – 8. mils, minimum

Concrete in Contact with Sewage (Paint/coat only when scheduled in Table A-2 or on the architectural drawings)

System C-2	Sherwin-Williams	PPG	Tnemec	Remarks
Surface Preparation	In accordance with SSPC-SP 13 Surface preparation of concrete			Allow concrete to cure 28 days prior to beginning coating operations
Prime Coat	Macropoxy 646 3.5-5.0 mils/coat	Amerlock 2/400	Series 218 at 1/16” - 1/4”	--
Intermediate Coat	--	--	--	--
Finish Coat	TARGUARD Coal Tar Epoxy	Amercoat 78HB	Series G435 at 60-80 mils	Top of wall to 3 feet below water line. Total DFT-80 mils minimum

Concrete Block, Open Porous or Rough Masonry - Interior

System C-3	Sherwin-Williams	PPG	Tnemec	Remarks
Surface Preparation	In accordance with ASTM D4261			Allow mortar joints to cure 28 days prior to beginning coating operations
Prime Coat	Cement-Plex 875 Acrylic Block Filler	Amerlock 400 BF	130-6602 Enviro-Fill 100-120 sf/gal	Fill all voids.
Intermediate Coat	Macropoxy 646 3.0-5.0 mils	Amerlock 2/400	Series V69 4.0-560 mils/coat	--
Finish Coat	Macropoxy 646 3.0-5.0 mils	Amerlock 2/400	Series V69 4.0-6.0 mils/coat	Total DFT – 16 mils minimum

TABLE A-1 (continued)

Concrete - Exterior (Paint/coat only when scheduled in Table A-2 or on the architectural drawings

System C-4	Sherwin-Williams	PPG	Tnemec	Remarks
Surface Preparation	In accordance with ASTM D4258			Allow concrete to cure 28 days prior to beginning coating operations
Prime Coat	ConFlex XL Textured High Build Coating A05W00800	Perma-Crete Matte Flex 4-310 Series	Series 157-Color Enviro-crete 111-148 sf/gal	--
Intermediate Coat	--	--	--	--
Finish Coat	ConFlex XL Textured High Build Coating A05W00800	Perma-Crete Matte –Flex 4-310 Series	Series 157-Color Enviro-crete 111-148 sf/gal	Total DFT – 12 mils minimum

Concrete in Contact with Raw or Potable Water (Paint/coat only when scheduled in Table A-2 or on the architectural drawings)

System C-5	Sherwin-Williams	PPG	Tnemec	Remarks
Surface Preparation	In accordance with SSPC-SP 13 Surface preparation of concrete			Allow concrete to cure 28 days prior to beginning coating operations
Prime Coat	Macropoxy 646 PW Epoxy B58Wx610 – Mill White B58Wx600 – Light Blue B58VX600 – Hardener B58VX605 (3-coats, total DFT – 14 mils minimum	Amerlock 2	Series 218 at 1/16” – 1/4”	Fill all voids.
Intermediate Coat		Amerlock 2	--	--
Finish Coat		Amerlock 2	Series 22/FC22 at 20-30 mils DFT	Total DFT – 30 mils minimum

Non-Submerged Masonry Walls – Glazed Wall Finish - Interior

System C-6	Sherwin-Williams	PPG	Tnemec	Remarks
Surface Preparation	In accordance with ASTM D4261			Allow concrete to cure 28 days prior to beginning coating operations
Prime Coat	Macropoxy 646 Fast Cure Epoxy	Amerlock 2/400	Series 27WB at 3.0-5.0 mils DFT	--
Intermediate Coat	--	--	--	--
Finish Coat	Macropoxy 646 Fast Cure Epoxy	Amerlock 2/400	Series 27WB at 3.0-5.0 mils DFT	Total DFT – 16 mils minimum

TABLE A-1 (continued)

Non-Submerged Ferrous Metal

System M-1	Sherwin-Williams	PPG	Tnemec	Remarks
Surface Preparation	SSPC-SP6/NACE 3 Commercial Blast Cleaning			Shop
Prime Coat	Pro Industrial ProCryl	Pitt Tech Plus 1300 Series	Series 394 PerimePrime 2.5-3.5 mils	Shop
Intermediate Coat	Sher-Cryl HPA-High Performance Acrylic B66W00350	Pitt Tech Plus 1300 Series	Series 1029-Color Enduratone, 2.0-3.0 mils	--
Finish Coat	Macropoxy 646 Fast Cure Epoxy B58W00610	Pitt Tech Plus 1300 Series	Series 1029-Color Enduratone, 2.0-3.0 mils	Total DFT – 7.5 mils minimum

General Ferrous Metal - Interior

System M-2	Sherwin-Williams	PPG	Tnemec	Remarks
Surface Preparation	SSPC-SP6/NACE 3 Commercial Blast Cleaning			Shop
Prime Coat	Macropoxy 646	Amerlock 2/400	Series 394 PerimePrime 2.5-3.5 mils	Shop
Intermediate Coat	Macropoxy 646	Amerlock 2/400	Series V69 4.0-6.0 mils/coat	--
Finish Coat	Macropoxy 646	Amerlock 2/400	Series V69 4.0-6.0 mils/coat	Total DFT – 12 mils minimum

Submerged Ferrous Metal

System M-3	Sherwin-Williams	PPG	Tnemec	Remarks
Surface Preparation	In accordance with SSPC-SP10/NACE 2 Near White Metal Blast Cleaning			--
Prime Coat	Macropoxy 646	Amerlock 2/400	Series 394 PerimePrime 2.5-3.5 mils	Shop
Intermediate Coat	Macropoxy 646	Amerlock 2/400	Series V69 4.0-6.0 mils/coat	--
Finish Coat	Macropoxy 646	Amerlock 2/400	Series V69 4.0-6.0 mils/coat	Total DFT – 12 mils minimum

TABLE A-1 (continued)

General Ferrous Metal - Exterior

System M-4	Sherwin-Williams	PPG	Tnemec	Remarks
Surface Preparation	SSPC-SP6/NACE 3 Commercial Blast Cleaning			Shop
Prime Coat	Macropoxy 646	Amerlock 2/400	Series 394 PerimePrime 2.5-3.5 mils	Shop
Intermediate Coat	Macropoxy 646	Amerlock 2/400	Series V69 4.0-6.0 mils/coat	--
Finish Coat	Hi-Solids Polyurethane 250 Polyurethane Semi-Gloss	Amercoat 450H	Series 1095-Color Endura-Shield 3.0-5.0 mils	Total DFT – 10.5 mils minimum

Ferrous Metal – Below Grade

System M-5	Sherwin-Williams	PPG	Tnemec	Remarks
Surface Preparation	In accordance with SSPC-SP10/NACE 2 Near White Metal Blast Cleaning			--
Prime Coat	--	--	--	--
Intermediate Coat	--	--	--	--
Finish Coat	TARGUARD Coal Tar Epoxy	Amercoat 78HB	46H-413 Hi-Build Tneme-Tar 16.0-20.0 mils	Total DFT – 16.0 mils minimum

Ferrous Metal Moving Parts Submerged in Sewage

System M-6	Sherwin-Williams	PPG	Tnemec	Remarks
Surface Preparation	In accordance with SSPC-SP10/NACE 2 Near White Metal Blast Cleaning			Shop
Prime Coat	Macropoxy 646	Amercoat 240	Series V69 4.0-6.0 mils/coat	--
Intermediate Coat	--	--	--	--
Finish Coat	--	--	--	Total DFT – 4 mils, minimum

TABLE A-1 (continued)

Ferrous Metal Submerged in Raw or Potable Water

System M-7	Sherwin-Williams	PPG	Tnemec	Remarks
Surface Preparation	In accordance with SSPC-SP10/NACE 2 Near White Metal Blast Cleaning			--
Prime Coat	Macropoxy 646 PW Epoxy B58LX610 – Mill White B58VX600 – Light Blue B58VX600 – Hardener B58VX605-OAP Hardener	Amerlock 2	Series 94H20 2.5-3.5 mils	--
Intermediate Coat	Macropoxy 646 PW as above	Amerlock 2	--	--
Finish Coat	Macropoxy 646 PW as above	Amerlock 2	Series 22/FC22 at 30-40 mils DFT	Total DFT – 32.5 mils, minimum

Uncertain Base Coat

System M-8	Sherwin-Williams	PPG	Tnemec	Remarks
Surface Preparation	Wash with Great Lakes No-Rinse Pre-Paint Cleaner and water, rinse thoroughly with clean water and allow to dry.			
Prime Coat	Macropoxy 5000	Amercoat 68MCZ	Series 394 PerimePrime 2.5-3.5 mils	
Intermediate Coat	--	--	--	Follow with appropriate system for exposure (minus the normal specified primer).
Finish Coat	--	--	--	--

Aluminum Surfaces in Contact with Concrete

System M-9	Sherwin-Williams	PPG	Tnemec	Remarks
Surface Preparation	In accordance with SSPC-SP16 Brush-off Blast cleaning of coated and uncoated galvanized steel, stainless steel and non-ferrous metals.			--
Prime Coat	Macropoxy 646	Amerlock 2/400	Series V69 4.0-6.0 mils/coat	--.
Intermediate Coat	--	--	--	--
Finish Coat	--	--	--	Total DFT – 5.0 mils minimum

TABLE A-1 (continued)

Interior Insulated Piping

System M-10	Sherwin-Williams	PPG	Tnemec	Remarks
Surface Preparation	Clean and dry			--
Prime Coat	DTM Acrylic Primer/Finish B66W00001	Pitt Tech Plus 1300 Series	1026-Color Tneme-Cryl 2.0-3.0 mils	--.
Intermediate Coat	--	--	--	--
Finish Coat	DTM Acrylic Primer/Finish B66W00001	Pitt Tech Plus 1300 Series	1026-Color Tneme-Cryl 2.0-3.0 mils	Total DFT – 5.0 mils minimum

Non-Submerged Ferrous Metal – Extra Corrosion Protection - Exterior

System M-11	Sherwin-Williams	PPG	Tnemec	Remarks
Surface Preparation	In accordance with SSPC-SP6/NACE 3 Commercial Blast Cleaning			Shop
Prime Coat	Corothane 1 Gal-Va-Pac Zinc Primer B65G00010	Amercoat 68MCZ	Series 394 PerimePrime 2.5-305 mils	Shop
Intermediate Coat	Macropoxy 646	Amerlock 2/400	SeriesV69 4.0-6.0 mils/coat	--
Finish Coat	Hi-Solids Polyurethane 250 Polyurethane Semi-Gloss	Amercoat 450H	Series 1095 Endurashield 2.5-3.0 mils	Total DFT – 9.5 mils minimum

Nonferrous Metal - Interior

System M-12	Sherwin-Williams	PPG	Tnemec	Remarks
Surface Preparation	In accordance with SSPC-SP16 Brush-off Blast cleaning of coated and uncoated galvanized steel, stainless steel and non-ferrous metals.			--
Prime Coat	Macropoxy 646	Amerlock 2/400	Series V69 3.0-36.0 mils/coat	--
Intermediate Coat	--	--	--	--
Finish Coat	Macropoxy 646	Amerlock 2/400	Series V69 3.0-5.0 mils/coat	Total DFT – 6.0 mils minimum

TABLE A-1 (continued)

Nonferrous Metal - Exterior

System M-13	Sherwin-Williams	PPG	Tnemec	Remarks
Surface Preparation	In accordance with SSPC-SP16 Brush-off Blast cleaning of coated and uncoated galvanized steel, stainless steel and non-ferrous metals.			--
Prime Coat	Macropoxy 646	Amerlock 2/400	Series V69 3.0-5.0 mils/coat	--
Intermediate Coat	--	--	--	--
Finish Coat	Hi-Solids Polyurethane 250 Polyurethane	Amercoat 450H	Series 1095 Endurashield 2.5-3.0 mils	Total DFT – 6.0 mils minimum

Galvanized Steel - Exterior

System M-14	Sherwin-Williams	PPG	Tnemec	Remarks
Surface Preparation	In accordance with SSPC-SP16 Brush-off Blast cleaning of coated and uncoated galvanized steel, stainless steel and non-ferrous metals.			--
Prime Coat	Corothane 1 Gal-Va-Pac Zinc Primer	Amercoat 68MCZ	Series V69 3.0-5.0 mils/coat	--
Intermediate Coat	Macropoxy 646	Amerlock 2/400	Series 1095 3.0-4.0 mils	Total DFT – 6.0 mils minimum

Galvanized Steel - Interior

System M-15	Sherwin-Williams	PPG	Tnemec	Remarks
Surface Preparation	In accordance with SSPC-SP16 Brush-off Blast cleaning of coated and uncoated galvanized steel, stainless steel and non-ferrous metals.			--
Prime Coat	Macropoxy 646	Amerlock 2/400	Series V69 3.0-5.0 mils/coat	--
Intermediate Coat	--	--	--	--
Finish Coat	Macropoxy 646	Amerlock 2/400	Series V69 3.0-5.0 mils/coat	Total DFT – 8.0 mils minimum

TABLE A-1 (continued)

Gypsum Board or Plaster Walls, Ceilings and Soffits – Interior

System G-1	Sherwin-Williams	PPG	Tnemec	Remarks
Surface Preparation	Clean and dry			--
Prime Coat	ProMar 200 Zero VOC 100% Acrylic Primer	Pure Performance 9-900 Interior Latex Primer	Premium Plus Interior Semi-Gloss Enamel	--
Intermediate Coat	DTM Acrylic Coating – Semi-Gloss	SPEEDHIDE 6-8510 Series 100% Acrylic – Semi-Gloss	Premium Plus Interior Semi-Gloss Enamel	--
Finish Coat	DTM Acrylic Coating – Semi-Gloss	SPEEDHIDE 6-8510 Series 100% Acrylic – Semi-Gloss	Premium Plus Interior Semi-Gloss Enamel	Total DFT – 6.0 mils minimum

Gypsum Board Walls, Ceilings, and Soffits. High Performance - Interior

System G-2	Sherwin-Williams	PPG	Tnemec	Remarks
Surface Preparation	Clean and Dry			--
Prime Coat	Macropoxy 646	Amerlock 2/400	Series 1029 2.0-3.0 mils	--
Intermediate Coat	--	--	--	--
Finish Coat	Macropoxy 646	Amerlock 2/400	Series 1029 2.0-3.0 mils	Total DFT – 5.0 mils minimum

Natural Wood - Interior

System W-1	General Finishes	PPG	Minwax	Remarks
Surface Preparation	Clean and Dry			--
Prime Coat	Enduro Ready to Match (RTM) Water Based Stain	Deft Wood Stain Interior – Oil-Modified, Water Based DFT300 Series	Water Based Pre-Stain Wood Conditioner followed by Water Based Wood Stain	--
Intermediate Coat	Enduro-Var Water Based Urethane - Satin	Deft Clear Wood Finish Interior Water Based Acrylic – Satin DFT109	Polycrylic Protective Finish - Satin	--
Finish Coat	Enduro-Var Water Based Urethane - Satin	Deft Clear Wood Finish Interior Water Based Acrylic – Satin DFT109	Polycrylic Protective Finish - Satin	--

TABLE A-2

EQUIPMENT FINISH SCHEDULE

Building or Area	Equipment	Paint/Coating System	Color
Main Pump Station	Influent pumps, piping and valves	M-2	Gray
Exterior	Exterior discharge header	M-4	Gray
General Equipment	Aluminum in contact with concrete	M-9	Black
	Wall sleeves (interior portion only)	M-5	Black
	Non submerged slide gate operators and non-aluminum parts (unless otherwise specified)	M-4	Light Brown
	Duplex strainers, backflow preventers, water meters	M-2	Match Pipe Color
	Hydrants – fire	M-4	As Selected By Owner
	Submerged ductile iron and steel pipe, supports, valves	M-3	Black
	Non-submerged interior ductile iron and steel pipe, supports, valves	M-2	Per Pipe Schedule
	Miscellaneous interior non-submerged ferrous metal	M-2	As selected by Owner
	Pipe bollards	M-4	Yellow
	Flow elements	M-2	Light Brown
	Floor drains	M-3	Black
	Lintels	M-13	Match Masonry Color
	Chemical feed system, feed pumps and supports (unless otherwise listed)	M-2	Light Gray
	Interior motors, drives, pump operators – non-submerged	M-2	Light Gray
	Interior ferrous metal – submerged or exposed to sewage	M-3	Black
	Interior ferrous metal – non-submerged	M-2	Light Gray
	Monorails, hoists and portable davit cranes (non-galvanized only)	M-2	Safety Yellow
Building interior and exterior surfaces	As scheduled on architectural drawings	As scheduled	As Scheduled
Tank finishes	As scheduled on architectural drawings	As scheduled	As Scheduled
General	Exterior motors	M-4	
	Interior pipe supports (per Section 15140)	As applicable	Match Abutting Surface
	Exterior pipe supports (per Section 15140)	As applicable	Match Abutting Surface
	Valves and operators (per Section 15060)	As applicable	Match Pipe
Miscellaneous fabrications	All applicable items in Section 05500	As applicable	
Doors	As scheduled on architectural drawings	As scheduled	As Scheduled

NOTE: Table A-1 and the Equipment Finish Schedule (Table A-2) are not intended to list every structure or equipment item to be painted.

TABLE A-3

PIPING COLOR AND LABEL SCHEDULE

Legend	Piping Nos. From Drawings	Label Color	Pipe Color[(1)]
Raw Influent	-	GR	Gray
Raw Sludge Line	-	GR	Gray
Sludge Recirculation Suction Line	-	BR/Y	Brown with Yellow Bands
Sludge Draw Off Line	-	BR/O	Brown with Orange Bands
Sludge Recirculation Discharge Line		BR	Brown
Digested Sludge Line	-	BK	Black
Sludge Gas Line	-	R	Red
Natural Gas Line	-	R	Red
Non-Potable Water Line	-	P	Purple
Potable Water Line	-	B	Blue
Fire Main	-	R	Red
Chlorine Line	-	Y	Yellow
Sulfur Dioxide	-	Y/R	Yellow with Red Bands
Sewage Line (wastewater)		GR	Gray
Compressed Air Line	-	DG	Dark Green
Process Air Line	-	LG	Light Green
Water Lines for Heating Digesters or Building	-	B/R	Blue with a 6-inch Red band spaced 30 inches apart
Fuel Oil / Diesel	-	R	Red
Plumbing Drains and Vents	-	BK	Black
Ferric Chloride	-	OR	Orange
Polymer	-	–	Unpainted PVC

Color Code:

GR = Gray with black letters
B = Blue with white lettering
LB = Light blue with white lettering
DB = Dark blue with white lettering
G = Green with white letters
LG = Light green with black letters
Y = Yellow with black letters
BK = Black with white letters
R = Red with white letters
BR = Brown with white letters
BK = Black with white letters
OR = Orange with white lettering
P = Purple with white lettering

Notes:

1. Do not paint/coat aboveground stainless steel, copper, FRP, or PVC pipe. Provide pipe labels only.

2. This table may not list every pipe to be painted/coated or labeled. All ferrous piping shall be painted/coated.

3. Pipe identification including labels and arrows shall be in accordance with Section 15076, Piping and Equipment Identification.

4. Where pipe is insulated, provide color bands and pipe labels on insulation.

5. Where applicable pipe color and label color shall match existing conditions. If there is a discrepancy between the existing pipe colors and scheduled colors, coordinate color with Owner and Engineer

PAINT SCHEDULE

Reviewed by Paint Mfg. Rep. _____

Interior or Exterior Surfaces to Be Painted and Major Equipment	Surface Preparation		Paint System	Product, Number of Coats, Dry Film Thickness, Coverage, Color, Shop Painting/Field Painting[1]			Painting Status	Remarks (Any Special Treatment or Application Requirements)
	Shop	Field		Prime Coat	Intermediate Coat	Finish Coat		

[1]Indicate whether the coating is provided by the Contractor (field painting) or equipment manufacturer (shop painting), where applicable.

DAILY EPOXY COATINGS INDUCTION RECORD

Date	Product	Location	Ambient Temperature (ºF)	Mix Start Time	Induction End Time	Total Induction Time Before Use

END OF SECTION

SECTION 09920

NON-SLIP EPOXY COATING

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Furnish and install a multi-coat seamless flooring system and all required accessories. The system is to be applied to existing concrete slabs in locations per Room Finish Schedule. The system includes, but is not limited to the following:

1. Moisture vapor transmission testing. Corrective treatment if required to create proper application conditions.

2. Surface preparation and cleaning, including abrasive blasting.

3. VOC compliant epoxy primer and sealer.

4. VOC compliant polyaspartic or polyamine epoxy top coating, applied in two coats, with embedded broadcast silica sand to achieve a slip-resistant surface.

5. VOC compliant aliphatic urethane top coat in areas of two colors.

6. Graphics, including stripes and lettering, of the same urethane material as the top coats, in a third and contrasting color, applied to the topcoat.

7. Joint treatments at control joints, floor/wall intersections and other interruptions in slab surface.

B. Mock-up location shall be of size and complexity as directed in Article 1.04 of this section.

1.02. REFERENCES

A. ASTM D4258 – Standard Practice for Surface Cleaning Concrete for Coating

B. ASTM D4259 – Standard Practice for Abrading Concrete

C. ASTM D4263 – Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method

D. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials

E. ASTM F1679 – Standard Test Method for Using a Variable Incidence Tribometer (VIT)

F. ASTM F1869 – Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

G. ASTM F2170 – Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

H. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source

I. SSPC-SP13/NACE 6 – Concrete

1.03. SUBMITTALS

A. Initial Submittal – Provide all initial submittal information concurrently under a single submittal number, and in accordance with Section 01300, Submittals. Submittals shall include, but not be limited to, the following:

1. Product Data - Provide data on specified products, including test results demonstrating compliance with specified requirements. Include product literature for all accessory materials.

2. Color Chart - Submit color charts showing the manufacturer's full range of available colors for top coat materials.

3. Manufacturer's Installation Instructions - Indicate special procedures if required for this specific installation.

4. Shop Drawings – Provide large scale details showing control joints, expansion joints, terminations at floor drains, transitions to adjacent floor materials, and cove base details for floating slabs at exterior frost walls and for slabs passing under steel stud framed walls with gypsum wallboard. Show specific details of adjacent construction for this project.

5. Maintenance Data - Include maintenance procedures, recommended maintenance materials, procedures for stain removal, repairing surface, and suggested schedule for cleaning.

6. Installer's Qualifications – Provide a letter from the finish system manufacturer verifying that the installing Contractor's personnel have been trained by the manufacturer in the installation of the specified system, or a system with similar installation requirements; and stating the manufacturer's approval of the installing Contractor for this work.

B. Preconstruction Submittals – After approval of the specified products and selection of colors; provide the following submittals:

1. Floor Finish and Graphics Mock-Up – To demonstrate workmanship and uniformity of coating thickness, install entire system, including color changes and stripes, to the floor as directed by the Engineer. Apply the field color for a distance of 4 feet out from the west, north and east walls of the room; and the walkway color in the remaining center area up to the edge of the slab under the door threshold. Add a 6-inch wide stripe in the contrasting graphics color centered over the boundary between field and walkway colors. Stencil two lines of 6-inch tall letters, centered in the walkway area with the bottom edge of lettering parallel to the door threshold. The top line is to read "WALKWAY;" the bottom line is to read "DO NOT OBSTRUCT."
If the mock-up work is sufficiently uniform and precise to satisfy the Engineer; it may remain part of the work. If not satisfactory, the finish in this area must be partially or wholly removed and reinstalled until it provides a satisfactory example of the standard expected for the locations scheduled to receive this finish.

2. Slabs scheduled to receive the epoxy floor finish are to be tested for humidity within the slab and moisture vapor transmission. After the building has been fully enclosed and HVAC systems have been in operation at occupied settings for a minimum of seven days; and prior to abrasive blasting and cleaning; humidity and moisture vapor transmission tests are to be taken. Data for ASTM D4263, ASTM F1869, and ASTM F2170 tests are to be recorded and copies submitted to the floor finish manufacturer's representative and to the Engineer.

3. Letter from the floor finish manufacturer's representative stating that s/he has reviewed the humidity and moisture vapor transmission reports, and has inspected the surface preparation for the floor finish, and certifies that these reports and observations indicate conditions that are compliant with the manufacturer's recommended conditions.

1.04. QUALIFICATIONS

A. Manufacturer's Representative – Individual qualified to inspect surface preparation conditions and assess the suitability of environmental conditions for successful application of the specified system. The individual must also be empowered to approve the granting of a warranty for the completed work.

1.05. REGULATORY REQUIREMENTS

A. Floor finish shall be classified under NFPA 253 as either Class I or Class II.

B. Conform to COMAR 26.11.33 including the VOC content limits listed under 26.11.33.05.

1.06. DELIVERY, STORAGE, AND HANDLING

A. Store finish component materials in a dry, secure area.

B. Maintain a minimum temperature of 55 degrees F.

C. Store materials for three days prior to installation in area of installation to achieve temperature stability.

1.07. ENVIRONMENTAL REQUIREMENTS

A. Do not install finish system unless substrate surface temperature, substrate moisture content, and air temperature and humidity are all within the recommended ranges specified by the system manufacturer.

B. Maintain curing conditions as recommended by the system manufacturer.

1.08. WARRANTY

A. Provide one-year warranty.

B. Warranty - Include coverage against flooring delamination from substrate and degradation of surface finish.

1.09. EXTRA MATERIALS

A. Provide 1 gallon of flooring material of each color selected.

PART 2 PRODUCTS

2.01. MANUFACTURERS

A. Entire system is to be supplied by a single manufacturer.

B. Acceptable manufacturers:

1. Carboline Company

2. Tnemec Company Incorporated

3. Sherwin Williams

4. Or approved equal

2.02. SYSTEMS

A. Power-Tread Series 237 by Tnemec, consisting of:

1. Primer – Surfacing Epoxy Series 215 – Modified Polyamine Epoxy filler and primer.

2. Power-Tread Series 237 Base Coat – Modified polyamine epoxy.

3. Silica Aggregate – Applied between base and intermediate coats to attain a slip-resistant texture to the floor finish.

4. Power-Tread Series 237 Intermediate Coat – Modified polyamine epoxy.

5. Everthane Series 248 – Aliphatic moisture cured urethane, applied in two colors: one designated as the “field” color; the other designated as the “walkway” color.

6. Everthane Series 248 – Aliphatic moisture cured urethane, applied in a third, contrasting color for stripe and letter graphics.

B. Sanitile 985 PA by Carboline, consisting of:

1. Primer – Carboguard 1340 WB waterborne epoxy filler and primer.

2. Sanitile 985 PA Base Coat – High-solids polyaspartic.

3. Silica Aggregate – Applied between base and intermediate coats to attain a slip-resistant texture to the floor finish.

4. Sanitile 985 PA Intermediate Coat – High-solids polyaspartic.

5. Carbothane 134 VOC – Aliphatic acrylic polyurethane, applied in two colors: one designated as the field color; the other designated as the walkway color.

6. Carbothane 134 VOC – Aliphatic acrylic polyurethane, applied in a third, contrasting color for stripe and letter graphics.

C. System by another manufacturer that:

1. Is of the same generic type.

2. Conforms to the performance requirements of this section.

3. Is approved by the Engineer as an equal.

2.03. ACCESSORIES

A. Vapor Blocking Mortar or Liquid Vapor Retarder

1. To be used only if required to meet the installation requirements for humidity and moisture vapor transmission of the substrate.

2. Type recommended by the finish system manufacturer for the particular project conditions.

B. Installation Accessories for Control Joints, Movement Joints and Cove Base

1. As recommended by the system manufacturer and shown on approved shop drawings.

2. Include as needed: joint sealants, compressible backers, reinforcing fabrics and edge termination sealants or trim.

3. Special installation tools recommended by the system manufacturer.

2.04. COLORS

A. Primer – Manufacturer’s standard color.

B. Base Coat or Undercoat – Light, neutral color that contrasts with top or sealer coat so that coverage may be visually verified.

C. Top Coat

1. Field Area – Medium gray such as Carboline Sanitile 985 PA color C703.

2. Walkway Area – Medium red such as Carboline Sanitile 985 PA color 0516.

2.05. BASE

A. Primer – Manufacturer’s standard color.

B. Base Coat or Undercoat – Light, neutral color that contrasts with top or sealer coat so that coverage may be visually verified.

C. Base Details

1. Cant cove where floor slab abuts or passes under concrete block or drywall partitions, 6 inches tall.

2. Compatible urethane sealant over compressible filler where floating slab terminates adjacent to exterior walls.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify that surfaces are smooth and flat with maximum variation of 1/4 inch in 10 feet and are ready to receive work.

B. Verify concrete floors have cured a minimum 28 days, meet manufacturer's recommendations for humidity and moisture vapor transmission, and exhibit negative alkalinity, carbonization, or dusting.

C. If moisture testing exceeds manufacturer's limits, install manufacturer approved vapor barrier such as vapor blocking mortar. Verify that slabs with barrier meet manufacturer's recommended limits.

D. Verify floor is free of substances that may impair adhesion of new adhesive and finish materials.

3.02. PREPARATION

A. Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes, and other defects with sub-floor filler.

B. Shot blast or mechanically abrade (scarify) to remove laitance, curing compounds, sealers, and other contaminants, and provide required surface profile per flooring manufacturer.

C. Vacuum clean substrate.

D. Conformance to ASTM D4258 and ASTM D4259, or SSPC-SP13/NACE 6, is the minimum acceptable level of preparation.

3.03. INSTALLATION – FLOORING

A. Before starting installation: verify that substrate temperature, air temperature and relative humidity are within the manufacturer's recommended ranges and will remain stable during curing times.

B. Apply each layer of the system in accordance with manufacturer's instructions.

C. Apply each layer at the upper end of the manufacturer's recommended thickness.

D. Broadcast silica or quartz aggregate at layer in system as recommended by the manufacturer to achieve the required slip resistance.

E. Sequence the installation of joint and base accessories as recommended by the system manufacturer to achieve the details shown by approved shop drawings.

F. Install stripes and lettering of top coat materials where shown on drawings and as directed by Engineer.

3.04. PROTECTION OF FINISHED WORK

A. Prohibit traffic on floor finish for 48 hours after installation.

B. Barricade area to permit uninterrupted curing.

C. Install base divider strips at all boundaries between sections of finish installed at different times.

END OF SECTION

SECTION 10441

SIGNS

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Interior and exterior wall-mounted fiberglass signs.

B. Safety warning signs.

C. Instructional signs.

1.02. SUBMITTALS

A. Submit under provisions of Section 01300, Submittals.

B. Manufacturer's Data - Submit descriptive literature and specifications, including color chart.

C. Submit shop drawings depicting sign styles, lettering font, foreground and background colors, locations above finished floor and adjacent to doors, a list of all signs to be provided indicating sign location and text, and overall dimension of each sign and method of attachment.

D. Submit manufacturer's standard warranty information.

1.03. REGULATORY REQUIREMENTS

A. Wall-mounted signs shall conform to ICC/ANSI A 117.1 - 1998 - Accessible and Usable Buildings and Facilities, Sub-chapter 703.

1.04. DELIVERY, STORAGE, AND HANDLING

A. Sign packages shall have exterior labels indicating the name of the building or buildings where they are to be installed.

B. Store adhesive or tape materials at temperatures within the manufacturer's recommended installation temperature range.

1.05. ENVIRONMENTAL REQUIREMENTS

A. For mounting methods utilizing adhesive or tape materials: do not install signs when ambient temperature is below 70 degrees F. Maintain this minimum during and after installation of signs.

PART 2 PRODUCTS

2.01. MANUFACTURERS

A. Best Sign Systems, Inc., Montrose, CO

B. Apco Signs, Atlanta, GA

C. Seton Identification Products, Branford, CT

D. Or equal.

2.02. SIGNS

A. Exterior Building Designation Signs

1. Etched fiberglass with non-glare, UV-resistant painted surface.

2. Base material thickness to be 0.25 inch.

3. Minimum Width - 10 inches; minimum height: 3 inches.

4. Building name lettering and Braille as required by ICC/ANSI A 117.1 - 1998.

5. Raised white letters on black background.

6. Mounting by countersunk stainless steel screws in pre-drilled holes with expansion sleeves. Plastic spacing sleeves behind signs as required to attain plum and true alignment.

7. Best Sign Systems HC300, equal series by Apco Signs, or equal.

B. Safety Warning Signs/Equipment Signs

1. Where self-adhesive application is possible: flexible vinyl with a clear polyester coating or high-performance polyester.

2. Where it is necessary to mount the sign on railings or other framework near the hazard: 0.063 inch aluminum secured with stainless steel U-bolts or other appropriate stainless steel fasteners.

3. Rectangular signs are to be a minimum size of 10 inches wide by 7 inches high.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Beginning installation means installer accepts existing surfaces.

3.02. INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install signs after doors and surfaces are finished.

C. Building identification signs shall be mounted:

1. So that the baseline of characters shall be no less than 48 inches above, and no more than 60 inches above, the adjacent floor or ground surface.

2. Outside the room on the wall next to the door on the latch side. For double doors, the sign shall be mounted to the right of the right-hand door.

3. Where there is no wall space on the latch side of a single door, or to the right side of double doors, signs shall be mounted on the nearest adjacent wall.

4. If wall space is not available in any of the locations designated in items 1 through 3 above, signs may be mounted on the push side of doors provided that the doors are equipped with closers but do not have hold-open devices.

5. The same location specifications apply to signs associated with doors whether at the interior or at the exterior of buildings.

D. Safety warning signs shall be mounted so as to be clearly visible to the person approaching the equipment or area referenced by the sign. Sign locations shall be in compliance with OSHA regulations. Where possible, signs are to be mounted directly on the tanks, cabinets, or equipment referenced by the safety message. Coordinate mounting locations with Engineer.

3.03. REQUIRED SIGNS

A. Provide red "NON-POTABLE WATER - DO NOT DRINK" safety signs, per Paragraph 2.02.B, at the following locations:

1. Hose bibs.

2. Yard hydrants.

B. Provide "No Smoking" signs, per Paragraph 2.02.B, inside all entrances to each building.

C. Fire Extinguisher - Provide identifying sign at each unit per Paragraph 2.02.B.

END OF SECTION

SECTION 10522

FIRE EXTINGUISHERS

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Fire extinguishers as shown on plans.

1.02. REFERENCES

A. NFPA 10 - Portable Fire Extinguishers

B. UL 299 - Dry Chemical Fire Extinguishers

C. UL 711 - Rating and Testing of Fire Extinguishers

1.03. SUBMITTALS FOR REVIEW

A. Section 01300, Submittals: Procedures for submittals.

B. Shop Drawings - Indicate wall bracket mounted measurements and location.

C. Product Data - Provide extinguisher operational features, color and finish, and anchorage details.

D. Manufacturer's Installation Instructions - Indicate special criteria and wall coordination requirements.

E. Maintenance Data - Include test, refill or recharge schedules and re certification requirements.

1.04. QUALITY ASSURANCE

A. Provide units conforming with UL 711 and UL 299.

1.05. REGULATORY REQUIREMENTS

A. Conform to applicable codes and NFPA 10 for requirements for extinguishers.

1.06. ENVIRONMENTAL REQUIREMENTS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01. SCOPE

A. Provide two fire extinguishers for each door location unless otherwise noted on the Drawings. Locate the fire extinguishers after all other equipment and panels have been placed, and at the location determined by the Owner.

2.02. MANUFACTURERS

A. Manufacturers

1. Larsen’s Manufacturing Company - Model MP10.

2. JL Industries Incorporated - Model Cosmic 10E.

3. Buckeye Fire Equipment Company.

4. Or, an approved equal.

2.03. EXTINGUISHERS

A. Dry Chemical Type - UL 299, heavy duty steel tank with pressure gage; Classes A, B, and C fires, Size 10 lbs.

B. Extinguisher Finish - Epoxy enamel, red color.

2.04. ACCESSORIES

A. Extinguisher Brackets - Manufacturer’s standard formed steel, Larsen’s B-2 or equal.

PART 3 EXECUTION

3.01. EXAMINATION

A. Coordination: Verification of existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

3.02. INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install brackets plumb and level; secure rigidly in place 4 feet 4 inches from finished floor to top of fire extinguisher operating handle.

C. Fasten brackets into masonry construction with adhesive anchors.

D. Provide one fire extinguisher adjacent to each exterior personnel door. Maintain at least 6-inch clearance between edge of door and any part of extinguisher or bracket.

END OF SECTION

SECTION 10800

TOILET AND BATH ACCESS

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Toilet and washroom accessories, including the following:

1. Toilet tissue holder.

2. Soap dispenser.

3. Mirror.

4. Paper towel dispenser.

5. Waste receptacle.

B. Grab bars.

1.02. REFERENCES

ANSI A117.1	Accessible and Usable Buildings and Facilities
ASTM A123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A167	Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A269	Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM A1008	Steel Sheet, Cold-Rolled Carbon, Structural High Strength Low Alloy and High Strength Low Alloy with Improved Formability, Commercial Quality
ASTM B456	Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium
NEMA LD-3	High Pressure Decorative Laminates

1.03. SUBMITTALS

A. Submit under provisions of Section 01300, Submittals.

B. Product Data - Provide data on accessories describing size, finish, details of function, attachment methods. Product literature shall be clearly marked to the specific model, size, finish, and configuration.

1.04. REGULATORY REQUIREMENTS

A. Conform to ANSI A117.1 code for access for the disabled.

1.05. FIELD MEASUREMENTS

A. Verify that field measurements are as indicated and on product data furnished by the manufacturer.

1.06. COORDINATION

A. Coordinate the work with the placement of internal wall reinforcement and reinforcement of toilet partitions and shower stalls to receive anchor attachments.

PART 2 PRODUCTS

2.01. MANUFACTURERS

A. Bobrick, New York, NY.

B. Bradley Corporation, Menomonee Falls, WI.

C. American Specialties, Inc., Yonkers, NY.

D. Substitutions - Under provisions of Division 1 sections.

2.02. MATERIALS

A. Sheet Steel - ASTM A366.

B. Stainless Steel Sheet - ASTM A167, Type 304.

C. Tubing - ASTM A269, stainless steel.

D. Fasteners, Screws, and Bolts - Hot dip galvanized or stainless steel.

E. Expansion Shields - Fiber, lead, plastic, or rubber as recommended by accessory manufacturer for component and substrate.

2.03. FABRICATION

A. Weld and grind joints of fabricated components, smooth.

B. Form exposed surfaces from single sheet of stock, free of joints. Form surfaces flat without distortion. Maintain surfaces without scratches or dents.

C. Fabricate grab bars of tubing, free of visible joints, return to wall with end attachment flanges. Form bar with 1-1/2 inches clear of wall surface. Knurl grip surfaces.

D. Shop assemble components and package complete with anchors and fittings.

E. Provide steel anchor plates, adapters, and anchor components for installation.

2.04. KEYING

A. Supply three keys for each accessory to Owner.

2.05. FINISHES

A. Stainless Steel - No. 4 satin luster finish.

B. Backpaint components with paint or other effective means of isolation where contact is made with dissimilar metals to prevent electrolysis.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify that site conditions are ready to receive work and dimensions are as indicated on shop drawings and instructed by the manufacturer.

B. Verify exact location of accessories for installation.

3.02. INSTALLATION

A. Install accessories in accordance with manufacturer's instructions and ANSI A117.1.

B. Install plumb and level, securely and rigidly anchored to substrate with all fasteners concealed from view.

3.03. COMPONENTS

Item	Locations	Room Numbers	Bobrick*
20-inch Grab Bar Vertical	1 each	JA-101	B-6806 x 36
Two-Roll Toilet Paper Holder	1 each	JA-101	B-2740
Soap Dispenser	1 each	JA-101	B-4112
Mirror: 24 inches wide by 36 inches high	1 each	JA-101	B-290 2436
Stainless Steel Shelf	1 each	JA-101	B-295 x 18
Waste Receptacle	1 each	JA-101	B-2260

*Bradley or accessories from other manufacturers must be equal to Bobrick items listed.

END OF SECTION

SECTION 11291

SLIDE GATES

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Furnish, install, and test slide gates complete with operators, spare parts, manufacturer's services, and all other necessary appurtenances in compliance with the Contract Documents.

B. Furnish, install, and test the wet well slide gate complete with gate, actuator, spare parts, manufacturer's services, and all other necessary appurtenances, in compliance with the Contract Documents.

C. Data not specified in this section shall be the manufacturer's standard for the size equipment specified.

1.02. REFERENCES

A. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes

B. ASTM D2000 - Rubber Products

C. ASTM B505 - Standard Specification for Copper Alloy Continuous Castings

D. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications

E. ASTM D4020 - Standard Specifications for Ultra-High-Molecular-Weight Polyethylene Molding and Extrusion Materials

F. ASME/ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings

G. AWWA C561 - Fabricated Stainless Steel Slide Gates

1.03. PERFORMANCE REQUIREMENTS

A. All gates shall meet the leakage requirements of AWWA Standard C561, latest edition. In no case shall leakage exceed 0.10 gpm/ft of wetted seal perimeter in seating head and unseating head conditions.

1.04. SUBMITTALS

A. Provide in accordance with Sections 01300, Submittals; 01640, Equipment-General; and as supplemented herein. Submittals shall include, but not be limited to, the following:

1. Shop Drawings

a. Operating characteristics and nameplate data

b. Manufacturer's catalog information, descriptive literature, specifications, etc. for pumps, motors, and accessories.

c. Manufacturer's certified installation drawings containing all critical dimensions, weights, etc. required for installation of the equipment.

d. List of recommended spare parts other than those specified.

e. Electrical schematics.

f. Motor information.

g. Shop and field painting information. If no field painting is proposed, submit a certification from the manufacturer in accordance with Section 09900, Painting, for the Engineer's review and approval.

h. Shop and field testing procedures, equipment to be used and ANSI/HI testing tolerances to be followed.

i. Warranty.

2. Performance affidavits.

3. Certifications for iron and steel products in accordance with AIS requirements.

4. Shop test results.

5. Manufacturer's installation certificate.

6. Certification of equipment compliance.

7. Preliminary Field Test Reports

8. Functional Test Reports.

9. Training Plans.

10. Recordings of training sessions (to be completed by and coordinated with the Contractor).

11. Written training reports.

B. Provide operation and maintenance manuals and data where scheduled in Section 01640, Equipment–General.

1.05. SPARE PARTS

A. The following spare parts shall be provided in clearly identified dust-proof containers for each type of gate and gate actuator supplied:

1. One lift nut of each type provided.

2. One set of all bearings, O-rings, and seals.

3. Battery-operated drill-type tool suitable for operating the manual gates after removal of the gate handwheel. One drill-type tool shall be provided for each size operating nut.

1.06. EQUIPMENT WARRANTIES AND GUARANTEES

A. The supplier shall provide the following warranties and special guarantees in accordance with Section 01640, Equipment-General.

1. The equipment manufacturer shall guarantee for a period of three years starting at the time of equipment delivery to the job site or one year starting at the time of Substantial Completion (whichever is shorter), that the equipment supplied is free from defects in materials or workmanship and will meet the specified performance requirements when operated in accordance with the manufacturer's recommendations. The manufacturer shall correct any breach in this warranty at their expense.

PART 2 PRODUCTS

2.01. MANUFACTURERS

A. The slide gate manufacturers shall be the following:

1. Hydrogate

2. Or approved equal.

B. All gates provided under this Section 11291 shall be by a single manufacturer. The gate manufacturer is responsible for coordinating with Contractor.

2.02. OR EQUAL AND SUBSTITUTIONS

A. In the case of an "or-equal" or a substitution, demonstrate in writing, to the satisfaction of Owner that the manufacturer has produced the specified type and size of equipment for sanitary wastewater service that has been in successful operation for a minimum period of five years prior to the Bid date.

B. Submit information for an or-equal" or substitution as outlined in the General Conditions and Supplementary Conditions.

2.03. EQUIPMENT DESIGN

A. General

1. Gates shall be fabricated of the material of the size and type scheduled or detailed on the Drawings. Gates shall conform to the applicable standards listed herein.

2. All materials used in the construction of the gates and appurtenances shall be designed for the application and shall conform to the material specifications listed for each type of gate. All equipment including frames, discs, guides, stems, stem couplings, stem connections, assembly bolts, studs, nuts, and anchor bolts shall be designed for the design head such that the working stress shall not exceed 1/2 the tensile, compressive, and shear yield strength and 1/4 the ultimate tensile, compressive, and shear strength of the components.

3. All mating surfaces shall be accurately formed to ensure proper operation.

4. Gates shall be of the rising stem type unless otherwise noted on the gate schedule or Contract Drawings. Clear butyrate-plastic pipe covers with mylar position indicators shall be furnished and installed on all rising stems.

5. Gates shall be fabricated in the United States and made of U.S.-forged metals.

6. Existing frames shall be replaced with new frames for all gate installations

B. Stainless Steel Gates

1. General – Stainless steel slide gates shall conform to ANSI/AWWA C561-04, except where modified by this section.

2. Materials

a. Frames, discs, guides, yokes, stem and stem couplings, stem guide bushings, mounting brackets, rising stem thrust nuts, actuator pedestals, and floor stands shall be Type 316/316L stainless steel as designated in the gate schedule. Type 316/316L shall be used for all welded components.

b. Wall thimbles shall be constructed of the same material as the gate disc unless otherwise indicated in the gate schedule.

c. Side seals, invert seals and top seals shall be ultra-high molecular weight polyethylene (UHMWPE) meeting ASTM D4020.

d. Flush bottom seals and seats shall be UHMWPE meeting ASTM D4020. Flush bottom seals and seats may also be neoprene or EPDM meeting ASTM D2000.

e. Lift nut and non-rising stem thrust nut shall be bronze meeting ASTM B584 or ASTM B505.

f. Gear housing and handwheel or crank shall be cast iron or aluminum.

3. Disc

a. The disc or sliding member shall have a minimum thickness of 1/4 inch for all members except seal retainers.

b. Slide deflection shall not exceed 1/720 of gate width at maximum design head.

4. Stems and Stem Connections - The gate stem shall be connected to the disc by a thrust nut or a thru-bolt connection. The stem connection shall prevent rotation of the thrust nut.

a. Rising stem thrust nuts shall be threaded and keyed or threaded and pinned to the stem.

b. Non-rising stem thrust nuts shall be threaded but not keyed.

C. Guides and Frames

1. Guides and frames shall have a minimum material thickness of 1/4 inch for all members except seal retainers. Guides shall be integral with frame or bolted to the frame.

2. The disc shall engage the guides for the full length of the disc. Lateral clearance between disc and guides shall permit free travel.

3. Guides shall support at least two thirds of the disc height when the disc is in full open position. Guides shall be of sufficient length to ensure that the gate operates with a smooth, even, uniform movement without jerking, binding or twisting.

4. Frames designed for mounting on the face of concrete shall be provided with a flanged back design and holes for anchor bolts every 18 inches. Frames designed for embedment in concrete shall be provided with keyways to lock into the concrete.

5. Self-contained gate frames shall extend above the disc full-open position or above the top of the wall and shall have structural members welded or bolted between guides to form a yoke to support the gate actuator.

D. Seats and Seals

1. Gate assemblies shall have an integral self-adjusting seat-seal system to restrict leakage as specified and prevent metal to metal contact between the frame and slide. Adjustable wedges, wedging devices, or pressure pads are not permitted.

2. Gates utilizing “J” seals or “P” seals are not acceptable.

3. Seal system shall be of UHMW polyethylene construction.

4. Seats and seals shall be secured to the frame or the disc to ensure they will remain in place, free from distortion or loosening during the life of the gate.

5. Seating-sealing surfaces shall contact their mating surface to meet the leakage requirements specified herein.

6. Seat contact pressure shall not exceed 600 psi at the design head. Top and bottom seat are considered as non-load bearing for this calculation.

7. Where the top of the guide extends to the top of an adjacent wall or bottom of an elevated slab, the gate assembly shall also have a plate or bar mounted at the top of the opening to form a top seat.

8. Flush Bottom Seals

a. Where the gate invert level is shown on the Contract Drawings to match the surrounding structure invert elevation, gates shall be flush bottom.

b. Flush bottom seals shall meet leakage requirements specified herein.

c. The flush bottom seal shall be mounted on the disc or the frame and shall be held securely in place, free from distortion or loosening during the life of the gate. When seal is mounted on the disc, a machined stainless steel stop bar shall be bolted and keyed to the frame, forming a flush invert.

d. The shape of the seal shall produce a seating surface having a minimum width of 3/4 inch and the seal shall extend into the guide.

e. The vertical face of the seal shall be in contact with the seating surface of the guide to provide a proper seal at the corners.

E. Yokes

1. Self-contained gates shall be designed to withstand the thrust of the actuator when 40-lb. effort is placed on the handwheel or crank, with a minimum safety factor of four for ultimate tensile, compressive, and shear strength; and two for yield tensile, compressive, and shear strength.

2. Yokes for electric actuators shall be designed for a safety factor of 1.5 with regard to yield strength at the locked-rotor torque of the actuator.

3. Yoke deflection should not exceed 1/360 of gate width at maximum operating load.

4. The actuator mounting and guide contact surfaces shall be accurately formed to ensure proper stem alignment. The yoke shall be designed to allow removal of the slide from the gate assembly.

F. Stem and Stem Couplings

1. Gate stems shall be designed to have a maximum L/r (length/radius of gyration) of 200.

2. Threaded portion of the stem shall have a minimum outside diameter of 1-1/2 inches.

3. Stems, stem couplings, and stem connections shall be designed to withstand the load caused by application of 40-lb. effort on the crank or handwheel with a minimum safety factor of 2, 50-ft/lb. torque on the wrench nut, and 1.25 times the output thrust developed by the motor-locked rotor torque of the electric actuator and meet the minimum safety factor listed herein.

4. Stems of more than one section shall be joined by solid stainless steel couplings threaded and bolted, threaded and keyed, or bored and bolted to the stems. Stem couplings shall be of greater strength than the stems. All threaded and keyed couplings of the same size shall be interchangeable.

5. Threads shall be machine cut or rolled full depth Acme thread or American Standard General Purpose Acme thread. Where unified screw threads are used, the pitch may not be finer than Unified National coarse threading.

6. Gates shall be provided with stop collars or other positive means of preventing the gate from operating outside the intended range of disc travel. Stop collars or other approved methods of limiting gate motion shall be field adjusted according to the manufacturer's instructions at the time of gate installation.

G. Stem Guides

1. Stem guides shall be adjustable in two directions and shall be spaced at sufficient intervals to support the stem. Guide spacing shall not exceed 10 feet.

2. Stem guides shall be constructed of stainless steel with UHMWPE bushings.

3. Stem guide brackets may be mounted on the gate guides or yoke or may be mounted on the adjacent structure.

4. Wall-mounted guides shall provide lateral adjustment between the wall and the guide bracket and between the guide bracket and the guide for field alignment.

5. Guides mounted on the gate assembly shall be designed and fabricated to assure proper alignment. The guides shall allow for adjustment to permit proper alignment.

6. Stem guide assemblies and their anchor bolts shall be designed to maintain the alignment under all operating loads.

H. Accessories

1. Assembly bolts, studs, nuts, and anchor bolts shall be of size and thickness to meet the minimum safety factors listed herein.

2. Circular flanged-back gates mounting to pipe flanges shall mate with class 250-lb. or class 125-lb. drilling as specified in ANSI/ASME B16.1.

3. Mounting bolts or studs shall be of adequate number and spacing to seal the mounting flange and resist the shearing action caused by operating forces. Where adhesive anchors or expansion anchors are used, the bolt loads shall not exceed the bolt manufacturer's recommendations.

I. Gate Options

1. Self-Contained Gates

a. Gates so designated in the schedule or as shown on the Drawings shall have extended guides to allow the gate to fully open.

b. The guides shall be sufficiently strong to preclude further reinforcing.

c. The yoke shall be fabricated from the guide material and attached to the side guides to form a one-piece rigid frame.

d. The yoke shall have a bearing surface for a mounting plate for the operator.

e. Construction of the yoke shall allow the disc and stem to be removed without disconnecting the yoke.

f. Unless scheduled otherwise, all self-contained slide gates shall be rising stem.

J. Mountings

1. The slide gate equipment and appurtenances shall be installed in accordance with the Installation Manual furnished by the gate manufacturer. Extreme care should be used in handling, storage, and installation of this equipment to prevent damage or distortion of the equipment and to insure proper performance.

2. Gates shall be Mounted with flange back anchor bolt type arranged for upward opening gates mounted on concrete face or surface.

3. Dissimilar metals, such as stainless steel and ductile iron, shall be isolated in accordance with manufacturer recommendations.

4. Provide oversized gates or extra wide mounts for gates mounted over pipe penetrations.

2.04. GATE OPERATORS

A. General

1. Actuators shall be manual, electric, or hydraulic as scheduled.

2. Actuator shall have a bronze lift nut threaded to fit the operating stem.

3. Tapered roller or ball bearings shall be provided above and below the flange on the lift nut to take the thrust developed during gate operation.

4. All bearings and gears shall be enclosed in a weatherproof cast iron, ductile iron or aluminum housing, as recommended by manufacturer, with oil seals and O-rings or mechanical seals used to seal the unit.

5. Fittings shall be provided so that all bearings and gears can be periodically lubricated.

6. Actuator shall be supplied with pedestal, torque tube, or baseplate, machined and drilled for mounting the lift housing and ready for bolting to the operating floor, top wall mounting bracket, or gate yoke, as required.

7. The direction of wheel or crank rotation to open the gate shall be indicated on the actuator. Single-speed actuators shall open counterclockwise and two-speed actuators shall open counterclockwise for the low mechanical-advantage gear ratio. Single-speed actuators at the high mechanical advantage gear ratio shall open clockwise.

8. All gates 48 inches and wider and having widths greater than twice their height shall be provided with dual stems and with two actuators connected by a tandem shaft for simultaneous operation unless otherwise specified. Cross shafting shall be stainless steel. Flexible couplings shall be provided at either end of the cross shafting.

9. Actuator shall be sized to permit slide operation with an effort of not more than 40-lb. pull on the handwheel-hand crank for rising stem or 50-ft/lb. torque on the lift nut input shaft for non-rising stem.

10. Non-rising stem manual operators shall have a position indicator with a dial or digital display in in full step with gate to show the position of the gate at all times. Indicator dial shall be graduated in 25 percent increments at a minimum. Rising stem manual operators shall have mylar position indicators shown on the stem cover in 25 percent increments at a minimum.

11. Each rising stem actuator shall be provided with a stem cover unless otherwise specified. Cover shall be made of clear butyrate-plastic pipe that will not discolor, crack, or become opaque for at least five years after installation.

12. Floor stands shown on the Contract Drawings or designated in schedule to be mounted on vertical wall shall be provided with a bracket suitable for wall mounting.

13. Floor stands shown on the Contract Drawings or designated in schedule to be mounted over grated areas, mounting brackets shall be oversized larger than floor stand baseplate with 2-inch clearance on all sides to allow for support of adjacent grating.

14. Floor stands shall be fabricated from stainless steel. The adaptor plate and baseplate shall have a minimum thickness of 1/2 inches.

15. Baseplate shall be designed so as not to interfere with any adjacent grating, walls, or any other mechanical equipment.

B. Manual

1. All actuators shall be supplied with a 2-inch square operating nut, and either a removable cast iron or aluminum crank arm with revolving brass grip or a removable cast iron or aluminum handwheel as scheduled.

2. Handwheels shall be direct drive-type handwheel without reduction gearing. The maximum handwheel diameter shall be 24 inches.

3. Crank actuators shall be provided with single or double-reduction gearing as necessary to meet lifting capacity.

a. Drive gears used in gear reduction actuators shall be steel and accurately machined, with cut teeth to provide smooth and proper operation.

b. Input shafts shall be stainless steel and supported by tapered roller or other roller-type bearings designed to withstand the radial and thrust loads generated during operation.

c. All geared actuators shall be suitable for operation by use of a portable motor apparatus.

d. The maximum crank radius shall be 15 inches.

2.05. FABRICATION REQUIREMENTS

A. Contractor shall verify all dimensions and notify the Engineer of any discrepancies prior to fabrication.

B. Manufacturer shall provide surface preparation and prime coating in accordance with the coating system specified in Section 09900, Painting. Manufacturer's standard surface preparation and prime coating are acceptable if the equipment manufacturer certifies that the coating meets or exceeds requirements specified in Section 09900, Painting, and is approved by the Engineer.

C. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.

D. Anchor bolts shall be Type 316 stainless steel.

E. Isolate dissimilar metals with dielectric using appropriate fasteners.

F. Welds shall be continuous unless noted otherwise.

G. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

H. Furnish nameplates for each gate in accordance with Section 01640, Equipment-General.

1. Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins.

2. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the equipment performance ratings.

I. Where it does not affect system performance, all sharp edges of equipment shall be rounded with edge grinding or other means to provide satisfactory paint adherence and prevent injury.

2.08 SHOP TESTING

A. Equipment shall be tested in the manufacturer’s shop in accordance with the requirements of Section 01640, Equipment-General, and as specified herein.

1. The gates and operators shall be completely shop assembled, inspected, and tested to ensure proper operation, fit, and adjustment of all parts.

2. The gates shall be fully opened and closed in the guide system to ensure they operate freely.

PART 3 EXECUTION

3.01. EQUIPMENT INSTALLATION

A. Install in accordance with the Contract Documents and the manufacturer’s written instructions.

B. Actuators shall be installed in accordance with the slide gate and actuator manufacturers’ recommendations.

C. No modifications to equipment shall be made without the written consent of the manufacturer and approval of Engineer.

D. The General Contractor is responsible to field verify all dimensions and elevations prior to submittal review. Notify Engineer of specific differences.

E. The General Contractor is responsible to ensure the specified equipment fits in the designated spaces without conflicts. The General Contractor is responsible to correct and resolve all conflicts at no additional cost to the Owner.

F. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) for testing and startup.

G. Surface preparation and field painting shall be in accordance with Section 09900, Painting.

H. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.

I. Backpaint aluminum in contact with painted or galvanized steel or concrete with 5 mils of Tnemec Series 66-Gray, Hi-Build Epoxoline or DuPont 25P Epoxy.

J. Isolate dissimilar metals by backpainting or with dielectric using stainless steel fasteners.

K. All necessary attaching bolts and anchor bolts shall be ASTM A276 Type 316 stainless steel and shall be furnished by the slide gate manufacturer.

1. All slide gates mounted on concrete faces or walls shall have a mastic seal or gasket provided between the concrete face and guide frame back.

3.02. TESTING AND STARTUP

A. Testing and startup shall be performed in accordance with Section 01660, Testing and Startup, and as specified herein unless otherwise noted.

1. Preliminary field testing.

2. Functional testing.

3. Startup.

B. All testing shall be done in the presence of the Engineer and the equipment manufacturer or their approved representative.

C. Preliminary field test shall demonstrate the following:

1. Equipment is permanently installed in the correct location and orientation.

2. Equipment is properly adjusted, aligned, and lubricated.

3. Equipment is prepared for operation in strict accordance with the Contract Documents and with manufacturer's recommendations.

D. Functional Test shall consist of the following tests:

1. Verification of compliance with all seating tolerances and leakage requirements. Contractor is responsible for supplying any plugs, pumps, weirs, etc., necessary to conduct the tests, including means to accurately measure the quantity of water leaked.

2. The gate disc shall be fully opened and closed, in the field, to ensure that it operates freely and that the required clearance between the frame and gate guide groove is maintained.

3. The electrically and hydraulically actuated gates shall be fully opened, fully closed, and modulated in the field, to verify proper operation of the gate and actuators.

4. Verification that the hydraulically actuated gate will close in the event of a power failure

E. Adjust, repair, modify, or replace any components of the system that fail to meet all specified requirements.

3.03. SERVICE OF MANUFACTURER'S REPRESENTATIVE

A. Provide services of the equipment manufacturer or their approval representative in accordance with Section 01640, Equipment-General, and as specified herein.

B. A qualified representative of the equipment manufacturer shallbe on site for the following activities:

1. Installation.

2. Preliminary field testing.

3. Functional testing.

4. Startup.

5. Training.

6. As necessary to provide submittals in accordance with Article 1.06.

3.04. EQUIPMENT SCHEDULE

A. All equipment furnished under this section shall be in accordance with equipment schedule on the following page.

(continued)

SLIDE GATE SCHEDULE

Tag ID	Location	Size of Opening (W x H) (inches)	Slide Height (inches)	Type	Gate Type	Gate Material	Operator	Bottom of Gate Elevation		Operating Deck Elevation	Notes
								Fully Raised	Fully Lowered		
SLIDE GATES											
UH-01	Union Hill Pump Station Wet Well	24”x24”	17.25”	Flange Back Anchor Bolt	Rectangular	Stainless Steel	Manual	359.4ft	358ft	372 ft	1, 2, 3
UH-02	Union Hill Pump Station Wet Well	24”x24”	17.25”	Flange Back Anchor Bolt	Rectangular	Stainless Steel	Manual	359.4ft	358ft	372 ft	1, 2, 3
UH-03	Union Hill Pump Station Wet Well	20”x30”	30”	Flange Back Anchor Bolt	Rectangular	Stainless Steel	Manual	368.9ft	366.4ft	372 ft	1, 2, 3
UH-04	Union Hill Pump Station Wet Well	20”x30”	30”	Flange Back Anchor Bolt	Rectangular	Stainless Steel	Manual	368.9ft	366.4ft	372 ft	1, 2, 3
UH-05	Union Hill Pump Station Wet Well	20”x30”	30”	Flange Back Anchor Bolt	Rectangular	Stainless Steel	Manual	368.9ft	366.4ft	372 ft	1, 2, 3
UH-06	Union Hill Pump Station Wet Well	24”x24”	17.25”	Flange Back Anchor Bolt	Rectangular	Stainless Steel	Manual	358.65ft	357.25ft	372 ft	1, 2, 3
TA-01	Tallman Pump Station Wet Well	24”x24”	24”	Flange Back Anchor Bolt	Rectangular	Stainless Steel	Manual	477.5ft	475.5ft	485 ft	1, 2, 3
TA-02	Tallman Pump Station Wet Well	24”x24”	24”	Flange Back Anchor Bolt	Rectangular	Stainless Steel	Manual	477.5ft	475.5ft	485 ft	1, 2, 3
TA-03	Tallman Pump Station Wet Well	24”x24”	24”	Flange Back Anchor Bolt	Rectangular	Stainless Steel	Manual	475ft	473ft	485 ft	1, 2, 3

Notes:

1. All elevations are based off of existing drawings provided by The Rockland County Sewer District No. 1. Contractor shall field verify all elevations and notify the Engineer of any discrepancies prior to fabrication.
2. Gates and frames are replacing existing equipment or shall be installed in an existing structure. Contractor shall field-verify existing channel widths, depths, openings, and conditions for new gate and notify the Engineer of any discrepancies prior to fabrication.
3. Equipment installed shall be suitable for use in a Class I, Division 1, Group D area.

END OF SECTION

SECTION 11300

PUMPING EQUIPMENT - GENERAL

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Gauges on suction and discharge sides of pump.

B. Sight flow indicators.

C. Diaphragm Seals.

D. Nameplate requirements.

E. Shop and field tests.

F. Services of manufacturer’s representative.

PART 2 PRODUCTS

2.01. GAUGES

A. Gauges shall be installed on the suction and discharge sides of pumps in accordance with the following specifications.

1. Gauges shall be of the bourdon tube type with 4-1/2-inch diameter dial and with diaphragm seal.

2. Case and ring shall be black epoxy coated aluminum, bourdon tube shall be phosphor bronze with a brass tip and window shall be glass.

3. Gauges shall be stem mounted and shall be installed close to the suction and discharge flanges of the pump.

4. Gauges shall be calibrated to read zero at atmospheric pressure.

5. The suction gauges shall be of the compound type to indicate both pressure and vacuum; they shall be calibrated to read 25 feet of water above and below zero.

6. The discharge gauges shall be calibrated to read from 0 feet to a minimum of 5 feet of water pressure above pump shutoff head.

7. Gauges shall be Ashcroft No. 1379A (discharge) and No. 1379AC (suction); U.S. Gauge; or approved equal.

8. All gauges shall have continuous duty, clamped Teflon diaphragm seals as manufactured by Ashcroft, Type 300; U.S. Gauge; or approved equal.

9. Each diaphragm seal shall have Type 316 stainless steel upper and lower housings.

10. The lower housing shall be a threaded connection.

11. Gauges and diaphragm seals shall be by same manufacturer and shall be shipped as complete units, factory filled with silicone fluid.

12. Each gauge and diaphragm seal unit shall be connected with the necessary brass pipe fittings and a brass stopcock.

13. The Contractor shall coordinate with the various pump manufacturers so that all gauges are of one manufacturer.

14. No gauges shall be required on sump, polymer feed, or screw pumps.

2.02. SIGHT FLOW INDICATORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:

1. Dwyer Instruments, Inc.

2. KOBOLD Instruments, Inc. - USA.

3. Or approved equal.

B. Description: Piping inline-installation device for visual verification of flow.

C. Construction: Stainless-steel body, with sight glass and indicator, and threaded or flanged ends.

D. Minimum Pressure Rating: 125 psig.

E. Minimum Temperature Rating: 200 deg F.

F. End Connections for NPS 2 and Smaller: Threaded.

G. End Connections for NPS 2-1/2 and Larger: Flanged.

2.03. DIAPHRAGM SEALS

A. Continuous duty, clamped Teflon diaphragm seals shall be provided for all pressure gauges to be installed in suction and discharge piping that does not convey sludge or scum.

B. Pressure gauges and diaphragm seals shall be by same manufacturer and shall be shipped as complete units, factory filled with silicone fluid.

C. Each diaphragm seal shall have Type 316 stainless steel upper and lower housings. The lower housing shall be a threaded connection.

D. Each pressure gauge and diaphragm seal unit shall be connected with the necessary brass pipe fittings and a brass stopcock.

E. Pressure gauges and diaphragm seals shall be shipped as complete units, factory filled with silicone fluid.

F. Each diaphragm seal shall have Type 316 stainless steel upper and lower housings. The lower housing shall be a threaded connection.

G. Each diaphragm seal unit shall be connected with the necessary brass pipe fittings and a brass stopcock.

H. Diaphragm seals shall be Type 300 as manufactured by Ashcroft Inc.; or approved equal

2.04. NAMEPLATES

A. A brass or stainless steel nameplate shall be furnished for each pump with stamped characters readable under ordinary lighting conditions.

1. Pump nameplate shall give the rating in gallons per minute, rated head, speed and efficiency.

2. Additional data may be in accordance with the manufacturer's regular practice.

3. Nameplates shall be securely attached and not painted over.

2.04. SHOP TESTS

A. Tests shall be performed on the pumps in accordance with Section 01640 and the pump individual specification section.

1. Each pump unit shall be shop tested to determine compliance with the specifications, and the manufacturers shall submit to the Engineer and receive approval of five certified copies of test data before shipment of the pumps is made.

2. The Engineer and/or Owner reserves the right to witness the shop test on each pump before the pumps are assembled for shipment to the job site.

3. The pump manufacturer shall give the Engineer ample notice of these tests so that the Engineer can arrange to witness the tests.

4. Final acceptance, however, will be dependent upon the satisfactory operation and performance after installation.

PART 3 EXECUTION

3.01. PAINTING

A. Painting, including surface preparation, shall be in full accordance with Section 09900.

1. The pump manufacturer shall coordinate fully with the Contractor the system and application of paints used.

3.02. INSTALLATION OF EQUIPMENT

A. Pumping equipment shall be installed by the Contractor in accordance with Section 01640 and the pump individual specification section.

3.03. FIELD TESTS

A. Field tests shall be made in conformance with Section 01640 and the pump individual specification section.

B. Preliminary field tests shall be made after installation of the pumps. Final field tests shall demonstrate the following:

1. That the units have been properly installed and are in proper alignment.

2. That the units operate without overheating or overloading of any parts and without objectionable vibration.

3. That there are no mechanical defects in any of the parts.

4. That the pumps can deliver the specified pressure and quantity at the rated speed. The Contractor shall provide all temporary flow measurement devices as necessary to achieve accurate measurement of the pumped flow during the field tests.

5. That the pumps can pass the size of solids specified and the type of liquid for which the pumps are to be used.

3.04. SERVICES OF MANUFACTURER'S REPRESENTATIVE

A. Unless stated otherwise in the individual equipment section, the Contractor shall arrange for the equipment manufacturer to furnish the services of a qualified representative in accordance with Section 01640.

END OF SECTION

SECTION 11306

VERTICAL CENTRIFUGAL PUMPS

PART 1 GENERAL

1.01. SUMMARY

A. Furnish and install, four vertical centrifugal non-clog pumps, including shafts and motors, and variable speed drives, complete with all accessories and ready to operate at both pump stations, and provide spare parts, and manufacturer's services in compliance with the specifications and as shown on the Contract Drawings.

B. Manufacturer shall have sole responsibility for performance of the entire system to include all components listed above, shall be provided as a packaged system.

1.03. REFERENCES

A. Standards of the Hydraulic Institute.

B. AFBMA Std. 11 – Load and Fatigue Life of Roller Bearings.

C. ASTM A278 - Gray Iron Castings.

D. ASTM A743 - Standard Specifications for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application

E. NEC – National Electric Code.

F. NEMA – National Electrical Manufacturers Association.

G. AISI – American Iron and Steel Institute.

H. ANSI - American National Standards Institute.

1.04. DESIGN AND PERFORMANCE REQUIREMENTS

A. The pumps shall be able to fit through the existing hatch in the pumping station roof and ground floor as shown on the Contract Drawings.

B. The pump motors shall be guaranteed to run totally or partially for continuous 24-hour/day operation without damage.

C. Contractor shall provide fittings as necessary to accommodate the suction/discharge connections required to adapt to piping shown on Drawings.

D. The pumps shall be designed to pump municipal raw sewage containing solids and fibrous materials without clogging and without cavitation or excessive vibration or noise.

E. Each Pump shall be designed for the conditions of service tabulated as follows:

Union Hill Pumps:

Parameter	Value
Number of Units to be Supplied	4
Maximum Full Load Motor Speed (rpm)	1,800
Minimum Motor Horsepower (Hp)	150
Minimum Suction Size (inches)	8
Minimum Discharge Size (inches)	6
Minimum Shut-Off Head at Design Speed (feet)	242
System Static Head (feet)	115
Primary Design Point (each unit)	2,315 gpm at 166 -ft TDH
Minimum Efficiency at Primary Design Point (%)	72%
Maximum NPSHR at Primary Design Point (feet)	50
Secondary Design Point (each unit)	2,750 gpm at 158-ft TDH

Tallman Pumps:

Parameter	Value
Number of Units to be Supplied	4
Maximum Full Load Motor Speed (rpm)	900
Minimum Motor Horsepower (Hp)	150
Minimum Suction Size (inches)	10
Minimum Discharge Size (inches)	8
Minimum Shut-Off Head at Design Speed (feet)	155
System Static Head (feet)	78
Primary Design Point (each unit)	2,315 gpm at 130-ft TDH
Minimum Efficiency at Primary Design Point (%)	76%
Maximum NPSHR at Primary Design Point (feet)	19
Secondary Design Point (each unit)	2,750 gpm at 116-ft TDH

F. Solids passing capability of the pump shall be a minimum of a 3-inch spherical solids.

G. The pumps shall be provided with motors connected for operation on 460-volt, 1 phase, 60 Hertz power supply.

1.05. SUBMITTALS

A. Shop Drawings

1. Submit shop drawings for equipment provided under this section. Format and content of the shop drawing submittal shall conform to requirements specified in Section 01640.

2. The shop drawing submittal shall include the following as a minimum:

a. Manufacturer’s certificates including performance affidavit for all equipment furnished under this section.

b. Manufacturer’s published pump curves demonstrating compliance with specified performance requirements.

c. Manufacturer’s catalog information, descriptive literature, specifications, etc. for pumps, motors, and accessories, including pump seal assemblies and pressure gauges.

d. Manufacturer’s certified installation drawings containing all critical dimensions, piping connection sizes, weights, etc. required for installation of the equipment. Drawings shall include all pumps, interconnected piping, and valves. Coordinate with Contractor as required to produce drawings in REVIT format.

e. Shop and field painting information.

f. Motor information conforming to the requirements specified in Section 15170.

g. Manufacturer’s written installation instructions, including any special requirements for shipping, handling, and storage of equipment prior to installation.

h. Information regarding minimum and maximum pump and motor speeds.

i. Written statement from the motor manufacturer endorsing the use of their product with the variable frequency drives specified for these pumps in Section 16480.

j. Name of the independent firm who will provide vibration testing. The firm shall have been in business for at least five years and shall provide at least ten references for similar work performed. Provide proof of experience and references.

B. Shop Test Results - Submit shop test results, including certified pump curves for each pump provided, in accordance with requirements specified in Sections 01640 and 11300 showing as a minimum hydraulic efficiency, input power kW, wire to water efficiency, brake horsepower, flow versus head (minimum of 8 points) and vibrometer readings.

C. Operation and Maintenance Manual

1. Submit manufacturer’s written instructions for proper operation and maintenance of pumps, shafts, motors, and accessories provided under this section.

2. Format and content of the manufacturer’s operation and maintenance instructions shall conform to the requirements specified in Section 01640.

D. Manufacturer’s Certification of Equipment Compliance

1. Submit written certification of proper equipment installation and satisfactory completion of preliminary field testing by authorized field service representative of the equipment manufacturer.

2. Manufacturer’s certification and performance affidavit shall conform to requirements specified in Sections 01640 and 11300.

E. Unless the manufacturer is specifically named in these specifications, the following must be provided along with the shop drawings as required in 1.05.A:

1. A reference list showing that the proposed supplier is in compliance with paragraph 1.06.A.

2. The following information for the 10 references given in Article 1.05.E.1 so the Engineer is able to verify 10 of the installations:

a. Details of the equipment including pump, motor, and drive characteristics

b. Name and address of the client and location of installation, if different.

c. Name of person in direct responsible charge.

d. Telephone number and other contact information of person in direct responsible charge.

e. Installation and start-up dates.

f. Full installed pump performance details of specific pump(s).

It is the sole responsibility of the Contractor to provide the information necessary for the Engineer to contact these references.

F. Guarantee/Warranty

1. By supplying a product under the contract, the system supplier and manufacturers jointly agree that all manufacturer's warranties, expressed or implied, pass through the supplier to Owner. This warranty obligation starts on the date the pump(s) are placed into service following final performance testing and acceptance by the Owner and Engineer, and survives any inspection by, delivery to, acceptance by or payment by the Owner or system supplier for the goods furnished by the manufacturer. Further, this warrants that the equipment designed, manufactured and/or used meets all applicable federal, state, and local laws, rules, and regulations, including applicable OSHA standards. This requirement does not change or limit the requirements for performance affidavits.

2. Provide duplicate notarized copies of guarantees/warranties.

3. Submit prior to Final Application for Payment.

1.06. QUALITY ASSURANCE

A. The manufacturer of the equipment specified herein shall be regularly engaged in the design and manufacture of the type of equipment described herein for at least seven years. The manufacturer's experience will include at least 10 installations of similar design as that specified herein.

B. The pump manufacturer shall supply and deliver all materials, products, and services, etc. specified in this section for installation by others to the site. The pump manufacturer shall have total responsibility for pump system performance and conformance to assure proper interfacing and reliable operation of all components of the system.

1.07. SPARE PARTS

A. The manufacturer shall furnish the following spare parts in clearly identified containers. Provide one set of spare parts for each pump.

1. Two impellers with wear ring and fastener.

2. Set of line and thrust Bearings

3. Two shaft sleeves with keys, nuts, O-rings.

4. Two sets of gaskets and seals.

5. Two mechanical seal rebuild kits.

6. Two casing wear rings

PART 2 PRODUCTS

2.01. GENERAL

A. Pumps - The pumps provided under this section shall be as listed below:

1. Union Hill Pump Station: Flowserve Model 6MF18A as manufactured by the Flowserve Corporation, or approved equal.

2. Tallman Pump Station: Flowserve Model 8MF24A as manufactured by the Flowserve Corporation, or approved equal.

B. Dimensions and locations shown on the Contract Drawings are based on the equipment manufacturers and models listed above. Any change in the dimensions or location of equipment, including accessories, required to accommodate alternate manufacturers and models shall be at the Contractor’s expense.

C. The pumps, motors, drives, shafting and supports shall be designed and built for 24-hour continuous service at any and all points within the specified range of operation, without overheating, without damage cavitation, and without excessive vibration or noise.

D. In the case of equipment submitted for approval as an “or equal” to the manufacturers and models listed above, the Contractor shall demonstrate, in writing, at the time of shop drawing submittal, that the manufacturer has produced the specified type and size of equipment for sanitary wastewater service that has been in successful operation for a minimum period of 10 years prior to the bid date.

E. Each major piece of equipment shall be furnished with a stainless steel nameplate (with embossed data) securely mounted to the body of the equipment. As a minimum, the nameplate for the pumps shall include the manufacturer’s name and model number, serial number, rated flow capacity, head and speed. As a minimum, nameplates for motors shall include the manufacturer’s name and model number, serial number, horsepower, speed, input voltage, amps. Number of cycles, power and service factors.

2.02. PUMP DESIGN

A. Casing

1. Pump casing shall be of the one-piece volute-type with an integral discharge nozzle. Twin or double volute casings will not be accepted. No stationary guides will be permitted on either the suction or discharge sides of the casing.

2. Casing shall be made of close-grained cast iron conforming to ASTM A278 Class 30 nominal 0.81-inch thickness minimum for the 6MF18 model and 0.75-inch thickness minimum for the 8MF24, designed to withstand all stresses and strains of service at full operating pressure.

3. The casing shall be designed to permit the removal of the rotating assembly without disturbing the suction or discharge connections and shall be provided with a large handhole to permit inspection and cleaning of the pump interior. The handhole cover shall be bolted and its inner contour shall match the contour of the casing.

4. The casing shall be provided with tapped and plugged (removeable) vent, drain, and gauge connections. Suction and discharge connections shall be 125 lb. ANSI standard flat-face flanges positioned as indicated on the Contract Drawings. Each casing shall be hydrostatically tested in accordance with the latest Hydraulic Institute Standards. Hydrostatic test certification shall be provided prior to shipment.

5. Three lifting eyes minimum shall be furnished to facilitate handling.

6. Pump shall be supported by a fabricated steel stand. The stand shall be designed to support the pump, motor and motor support with a liberal safety factor. Design of the stand shall ensure that the suction elbow inlet flange does not touch the concrete or other support on which the pump is mounted. The stand shall allow access to the suction elbow handhole.

B. Impeller

1. The impeller shall be cast in one piece and shall have a minimum of two vanes. Impeller shall be non-clog and capable of passing a 3-inch diameter non-compressible sphere without deformation for the 6MF18A model and 7-inch diameter non-compressible sphere without deformation for the 8MF2A model.

2. The impeller shall be keyed to the shaft and firmly held in place by a streamlined Type 316 stainless steel fastener. The arrangement shall be such that the impeller cannot be loosened by torque from either forward or reverse rotation. The impeller bore shall be concentric to avoid requirement for sleeve nuts which could interfere with mechanical seals.

3. Impeller shall be ASTM A278 class 30 cast iron, machined and polished to remove projections that might encourage cavitation.

4. Each impeller shall be dynamically balanced to Grade 6.3.

5. Impellers shall be secured with a locking assembly and cover, design of which shall prevent the impeller from being loosened by torque from forward or reverse direction.

C. Suction Elbow

1. The suction elbow shall be furnished as part of the pump, of the same material as the casing and designed to provide equal flow distribution to the impeller eye. Standard commercial fittings shall not be substituted.

2. The suction elbow shall be provided with a 125-lb. ANSI flanged connection and a handhole with a removable bolted cover, the interior of which shall be contoured to match the contour of the piece.

3. The suction wear ring shall be in the casing.

4. Standard or fabricated commercial fittings are not an acceptable substitute.

D. Pump Shaft

1. Each pump shall be connected to its driver by means of universal joint intermediate shafting, suitably sized to transmit the required driving torque. Motors must be true vertical, PBase design. Horizontal motors adapted to the vertical position are not acceptable.

2. The pump shaft shall be made from heat treated grade 1045 steel, rigid shaft type, of sufficient size to transmit the full driver horsepower with a liberal safety factor, accurately machined over its entire length and free from any harmful or damaging vibrations. Renewable ASTM A479 type 316 hardened stainless steel shaft sleeves extending from the impeller hub through the stuffing box shall be provided.

3. Minimum shaft diameters for the 6MF18A model shall be 3.50 inches between bearings, 3.00 inches under sleeve, 3.54 inches under line bearing, 3.00 inches under thrust bearing, and 2.50 inches at impeller. Minimum shaft diameters for the 8MF24A model shall be 4.31 inches between bearings, 3.87 inches under sleeve, 4.33 inches under line bearing, 4.00 inches under thrust bearing, and 3.19 inches at impeller.

4. Shafts shall be protected by a sleeve made of 316 stainless steel. Sleeve shall be keyed to shaft and sealed to prevent leakage between sleeve and shaft. Shrink fit shaft sleeves will not be acceptable. The shaft sleeve O.D. shall be a minimum of 0.375 inches over the shaft diameter.

F. Bearings

1. Each pump shall be provided with bearings both radial and thrust, angular contact roller bearings, of ample size to carry all loads imposed under continuous operation without overheating.

2. All bearings shall be accessible while the pump is in operation. Bearing frame shall be designed so that the complete rotating element can be removed from the casing without disconnecting piping. Bearings shall be designed in accordance with the ABMA standards for a minimum L-10 life of 100,000 hours, without the addition of external cooling.

3. Bearings shall be grease lubricated, and a relief plug shall be provided so that excessive grease pressure will not damage the bearings.

4. Seals shall be provided in the bearing covers to prevent the entrance of contaminants.

5. The bearing frame shall be of one piece ASTM A48 Class 30 cast iron construction, rigidly fixed to the backhead, shoulder fitted and accurately centered. Fabricated bearing housings are not acceptable. The bearing frame shall contain external provisions for the axial adjustment of the rotating element to maintain clearance between the impeller and suction cover wearing rings as the rings wear. A coded shim pack shall be provided to aid in maintaining parallel faces.

G. Stuffing Box

1. The backhead shall be of the same material as the casing, with an integrally cast stuffing box. Its construction shall permit the use of either a mechanical seal or packaging rings without special machining. A large opening shall be provided adjacent to the stuffing box to facilitate packing or mechanical adjustment and replacement.

2. A renewable solids exclusion bushing shall be installed in the bottom of the stuffing box to minimize the amount of clean water injected into the box.

3. The Contractor shall provide the seal water piping and accessories as shown on the drawings.

4. Each pump shall be equipped with a PSS 4 split cartridge type mechanical seal, or approved equal. Seal shall be capable of being replaced without disassembly.

5. Seal faces shall be installed around the shaft, outside of the seal chamber. Seal faces shall be silicon carbide vs. silicon carbide. All metal components shall be either 300 or 420 series stainless steel. Mechanical seals shall be manufactured by pump manufacturer. Provide connection for seal water.

6. Proprietary stuffing box sealing systems are not acceptable.

H. Wear Rings

1. Removable hardened stainless steel wearing rings shall be provided for both the suction and the impeller, with the wearing surfaces normal to the axis of rotation to accommodate the adjustment feature specified further herein. Radial wear rings are not an acceptable alternate.

2. Rings shall be securely fastened to prevent any relative motions and designed for easy replacement.

3. Both wearing rings shall be hardened 400 series stainless steel, with the impeller wear ring hardened to 300-350 Brinell and the suction head wear ring to 400-450 Brinell, designed to compensate for a minimum of ¼-inch wear.

2.03. INTERMEDIATE SHAFTING

A. Intermediate shafting of the universal joint type shall be furnished and shall include pump and motor couplings and any required steady bearings. The number of sections shall be as recommended by the shafting manufacturer based on lateral/torsional analysis of data provided by the pump manufacturer.

B. Shafting shall be selected to have a B-10 bearing life of 20,000 hours for the industrial bearings and 50,000 hours for the steady bearings. Shafting shall avoid critical speeds and harmonics as recommended by the shafting manufacturer. Shafting manufacturer shall submit all data and calculations substantiating selection and number of sections.

C. Contractor shall furnish intermediate bearing supports where multiple shaft sections are required. Intermediate bearing supports shall be designed by a structural Professional Engineer licensed in the State of New York and retained by the Contractor. The structure shall be rigid in all planes. The natural frequency of the bearing support shall be a minimum of four times the running speed forcing frequency. The proposed support and design calculations shall be submitted for approval prior to construction. The existing shaft bearing support steel beams shall be replaced with equal or greater size. Manufacturer shall verify shaft and intermediate shaft bearing shall be adequately supported through use of the steel support beams.

D. Provide galvanized mesh guards enclosing shafting to a height of 7-feet above any floor or standing platform.

E. Shafting shall be as manufactured by Johnson Power LTD, or approved equal.

2.04. SURFACE PREPARATION AND SHOP PRIME PAINTING

A. Each pumping unit, including supports, shall be shop primed with universal rust inhibitive primer, Tnemec Series 1, or approved equal. The shop primer shall be compatible with the Contractors finish paint specified in Section 09900.

B. Motors shall have manufacturers standard finish paint for corrosive environments.

2.05. MOTOR

A. Pump motor shall be designed to operate on 480-volt, 3 phase, 60 Hertz power. Motors shall be inverter duty rated and have a minimum service factor of 1.15. Motor shall be suitable for use with variable frequency drives as specified in Section 16480. All motors shall comply with Section 15170. The manufacturer shall state in submittals any limitations on starting methods and steady running conditions. Motors shall be Premium Efficiency.

B. Provide a cylindrical steel motor support with welded base and end cap. The motor support is not intended to bridge large openings. The support shall be designed to elevate the motor to access the coupling and shall have adequate cut-outs to facilitate inspection.

2.06. CONTROLS

A. Provide VFD’s in accordance with Section 16480.

B. Pump monitoring – The pump manufacturer shall provide the following instruments with auxiliary contacts to monitor from destinations external to the panel:

1. Vibration – Horizontally and Vertically – Top of pump bearing frame.

2. Vibration – Horizontally and Vertically – Motor.

3. Temperature – Motor winding.

4. Temperature – Pump thrust bearing.

5. Temperature – Intermediate shaft bearing.

PART 3 EXECUTION

3.01. SHOP TESTING

A. Testing and Reporting Requirements

1. Each pump specified herein shall be factory tested in accordance with the latest edition of the Hydraulic Institute Standards. The tests shall be completed utilizing variable speed drives.

2. Tests shall be run on an open well (not a loop) with the pump pulling a suction lift.

3. Notification of such test and a list of test equipment and procedures shall be furnished to the Engineer at least 10 working days before the schedule test date.

4. The Engineer shall have the right to witness the factory tests and inspect any equipment to be furnished under this Section prior to their shipment from place of manufacture.

5. The Contractor shall make all arrangements and pay for all travel and expenses for up to three people from the Owner and Owner's Engineer to witness the shop tests.

6. Each pump shall be tested, and data recorded at its operating conditions of service as specified in Article 1.04 above, Section 11300, Section 15170, and Section 17095. Sufficient test point readings shall be made to establish complete head flow capacity, efficiency, and brake horsepower curves for each pump.

7. Pump shall be tested at variable speeds and speed curve shall be plotted on the performance curve. Affinity law calculations are not acceptable.

8. A complete test report for each pump, including certified characteristic curves of the pump consisting of at least all information required in Paragraph 1.03 above, except for NPSHR, and certified copies of the hydrostatic test report, shall be submitted to and approved by the Engineer before the pumps are shipped.

9. Factory test shall be performed with job motor and pump combination. Factory test with "shop" motor will not be acceptable.

10. Factory test shall not be used as acceptance testing.

B. A detailed signature vibration analysis shall be conducted at the factory prior to delivery on each unit including a bump test and X-Y vibration profiles to prove compliance with the specified vibration limits.

1. A written report will be submitted including a sketch of the unit indicating where and in which direction the vibration readings were taken and recorded showing peak to peak displacement in mils.

2. The manufacturer shall take corrective action to ensure full compliance with the specification and the units shall be retested.

C. All gauges and other test instruments shall be calibrated within 30 days of the scheduled test and certified calibration data shall be provided. All Venturi flow meters shall be calibrated as required by ANSI/HI standards.

3.02. EQUIPMENT INSTALLATION

A. Furnish and install the pumping equipment according to manufacturer's instructions, General Contract Provisions and Section 11300.

B. Furnish all necessary oil and grease for initial operation and for the one-year warranty period.

C. Contractor shall field verify all dimensions and elevations and shall notify Engineer of any specific differences. There is an existing hatch in the roof and in the upper floor of the Main Pump Station that can be utilized by the Contractor to transfer the pumps into the existing dry pit. Contractor shall be prepared to have to disassemble parts of the pump, if necessary, to fit through the existing hatches as well as to move the pumps within the dry pit.

D. Shaft Installation - The Contractor shall coordinate with the manufacturer to ensure an approved installation. If after the Contractor has completed the installation of the pumps in accordance with the requirements of the Specifications and as recommended by the Manufacturer, it is found that the installation continues to vibrate beyond allowable limits as established by "Hydraulics Institute Standards" the Contractor, when ordered by the Engineer, shall engage the services of an independent qualified testing firm to perform a vibration analysis of the defective unit to determine, in conjunction with the manufacturer, the source of the problem and what corrective measures should be taken to solve the problem. A detailed report of the findings shall be submitted to the Engineer.

E. Shaft Guards and Support Beams – It is the intent that the existing shaft guards and steel support beams be reused for this project. If, in the opinion of the manufacturer, the existing shaft guards and support beams cannot be reused, the Contractor is to furnish and install new guards and supports at no additional cost to the Owner. New guard installations must be submitted and approved by the Engineer.

3.03. FIELD TESTING AND INITIAL OPERATION

A. Tests, trials and initial operation shall be performed in accordance with the General Contract Provisions and Section 11300.

B. Operating tests in service shall be given to all pumps. The alignment of each pump, shafting and motor unit shall be proven straight and plumb and the satisfactory operation of each pump unit shall be demonstrated before the official test.

C. Final acceptance of the pumps will be made after each pump has met the stated performance requirements including meeting the hydraulic head and flow capacity as specified in Article 1.04, verification that the motors and drives are not overloaded in normal operating conditions, acceptable vibration testing results, and successful interface with all controls.

D. Field Testing

1. Furnish the services of pump manufacturer representative who has complete knowledge of the proper operation and maintenance to inspect the final installation and supervise testing of the equipment.

2. Field testing of all equipment shall be conducted after the installation is complete in the presence of the Owner, Engineer and manufacturer’s representative, to determine that operation is satisfactory and in compliance with specifications, the equipment has been operated and all necessary adjustments have been made.

    a. All equipment necessary for preliminary and field testing and the costs involved shall be borne by the Contractor/Manufacturer, including the services of the pump manufacturer's engineer and expenses incidental to retests, if any, occasioned by defects and failure of equipment to meet contract guarantees at the first tests. Water, electric current, water level indicators and recorders, flow meters, observers for taking readings, gauges, and connections for measuring the heads on the pumps shall be provided by the Contractor/Manufacturer.

    b. All expenses for conducting the field tests shall be part of the cost of the work.

    c. The pump manufacturer’s representative shall be present during both the field pump and vibration testing.

    d. Each unit will be operated utilizing screened plant influent wastewater for a period during which time all possible loads shall be applied. Data for at least four operating points shall be taken. Additional water needed to preform field test shall be supplied by the Contractor, as needed.

    e. During the field tests, readings of all essential data shall be recorded at the four operating points. Data taken shall also include discharge pressure, wet well level, total head, flow, and pump speed.

        1) Field tests results (head, capacity, efficiency) shall be approximately equal to the results obtained by the shop test.

    f. Results of the tests shall be submitted to the Engineer for approval.

    g. Vibration Analysis- A detailed signature vibration analysis shall be conducted on each pumping unit and shaft, including a bump test and X-Y vibration profiles to prove compliance with the specified vibration limits and to prove there are no field resonant conditions caused by misalignment, the foundation, the mounting or connecting piping and its supports, when operating over the range of design.

        1) The Contractor shall utilize the services of an independent qualified firm specializing in vibration analysis.

        2) A written report will be submitted including a sketch of the unit indicating where and in which direction the vibration readings were taken and recorded showing peak to peak displacement in mils.

        3) Vibration levels shall be within the acceptable limits for the type of pump and pump speed as given in the Hydraulic Institute Standards, most current Edition.

        4) The Contractor shall take corrective action to ensure full compliance with the specification and the units shall be retested.

        5) All defects or failures noted during the tests shall be corrected as approved by the Engineer. All costs associated with the required corrective action shall be borne by the Contractor.

C. Each pump shall be tested individually through the new discharge header and existing discharge pipeline to the aerated grit building utilizing screened plant influent. Flows shall be monitored and recorded by Contractor utilizing a flow measurement device provided by the Contractor throughout the testing period. Performance and efficiency tests of the pumps shall include tests to prove the capacity and efficiency of each pump at rated conditions.

a. Capacity and overall efficiency - The work done by the unit shall be determined by multiplying the total weight of water pumped figured at 62.4 lbs. per cu. ft. by the average total head. The overall efficiency shall be the ratio of the total work done to the power input to the motor, both expressed in like units. The quantity of water pumped will be measured by flow meters installed downstream of the pumping units (by Contractor).

b. Power input - Reading simultaneous with the capacity readings and total head readings shall be taken of the power input to the motor as determined by calibrated polyphase watthour meters or wattmeters to be located on the switchgear.

c. Accuracy of efficiency - The field test efficiency shall be within 2 points of the guaranteed efficiency at rated capacity and head. The 2 points allowable differential is to cover estimated deficiencies on flow, pressure, and power measurements for testing.

d. Submit copies of certified field test reports to the Engineer for review.

D. Following successful completion of testing of individual pumps, multiple pumps shall be tested together, up to a maximum of 5 pumps, through the new discharge header and existing discharge pipeline to the aerated grit building utilizing screened plant influent. Flows shall be monitored and recorded by Contractor utilizing a flow measurement device provided by the Contractor throughout the testing period.. Number of pumps that can be operated together may be dependent on incoming plant flows, Contractor shall be responsible for any additional water needed to preform field test.

E. Upon successful completion of initial pump testing as described above, entire facility shall be operated for a two-week period under normal operating conditions as a condition of receiving final acceptance. Flows shall be monitored and recorded by Contractor utilizing the Owner’s Parshall flume equipment in the aerated grit channel throughout the testing period. Owner will operate equipment under supervision of Contractor who shall still be responsible for system adjustments or repairs. If system or equipment repairs are needed, the test period shall restart.

3.04. SERVICES OF MANUFACTURER’S REPRESENTATIVE

A. Provide manufacturer’s (or supplier’s) services according to the General Contract Conditions and Section 01640.

END OF SECTION

SECTION 11501

TOOLS AND MISCELLANEOUS EQUIPMENT

PART 1 GENERAL

1.01. GENERAL

A. The Contractor shall furnish and install all maintenance tools, accessories, and miscellaneous equipment in compliance with Section 01640, the following specifications, and as shown, the Contract Drawings.

B. All items shall be new and of current design, free from defects, dents, rust, and other imperfections.

1.02. SECTION INCLUDES

A. Tools and miscellaneous equipment.

1.04. SUBMITTALS

A. Submit under provisions of the General Contract Conditions.

B. Shop drawings in accordance with Section 01640.

C. Operation and maintenance instructions in accordance with Section 01640.

D. Warranties in accordance with Section 01640.

1.05. DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of the General Contract Conditions.

B. Accept all tools and miscellaneous equipment on site. Inspect on arrival for damage.

PART 2 PRODUCTS

2.01. COMPONENTS

A. Equipment - Scheduled at end of Section.

PART 3 EXECUTION

3.01. INSTALLATION AND LOCATION

A. Install in accordance with manufacturer’s instructions.

B. Location for equipment placement is to be selected during construction by the Engineer, as shown on the Contract Drawings, or as detailed in the Schedule which follows.

C. Anchor attached equipment securely in place.

3.02. SCHEDULES

A. Lubrication Equipment

1. Provide lubrication equipment and an initial stock of lubricants for all equipment supplied under this contract. The type of lubricants to be in accordance with equipment O&M Manuals.

2. Grease shall be supplied in cartridge form where feasible and the total grease supply shall be 10 lbs. of each type.

3. Each type of oil shall be supplied at a minimum of 70 gallons.

4. Schedule

a. Six grease guns with cartridge and suction filling features with three flexible and three straight extensions for the grease guns. Grease guns will match the standardized grease fittings as specified in Section 01640. Manufacturers: Alemite Model 800 or Lincoln.

b. Four 1-pint capacity hand oilers with two flexible and two straight extensions for oilers. Manufacturers: Plews or USA Eagle.

END OF SECTION

SECTION 15060

ABOVEGROUND PROCESS PIPING

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Furnish, install, and test aboveground process piping complete with all fittings, appurtenances and all other required accessories in accordance with the Contract Documents.

1.02. REFERENCES

A. Ductile Iron and Gray Iron Pipe

Handbook of Cast Iron Pipe - Cast Iron Pipe Research Association (CIPRA)	CIPRA Standard for Flanged Pipe With Threaded Flanges
ANSI A21.4/AWWA C104	Cement-Mortar Lining for Ductile Iron and Gray Iron Pipe and Fittings for Water
ANSI A21.10/AWWA C110	Ductile Iron and Gray Iron Fittings, 3-inch through 48-inch, for Water and Other Liquids
ANSI A21.15/AWWA C115	Flanged Ductile Iron and Gray Iron Pipe With Threaded Flanges
ANSI A21.50/AWWA C150	Thickness Design of Ductile Iron Pipes
ANSI A21.51/AWWA C151	Ductile Iron Pipe Centrifugally Cast in Metal Molds and Sand Lined Molds for Water and Other Liquids
ASTM A126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A536	Ductile Iron Castings
ANSI/AWWA C606	Grooved and Shouldered Joints

B. Copper Pipe and Fittings

ASTM B32	Solder Metal
ASTM B88	Copper Pipe; Type L for Inside Service
ASTM B584	Copper Alloy Sand Castings for General Applications
ASME/ANSI B16.18	Cast Copper Alloy Solder Joint Pressure Fittings

C. Other

ASTM A47	Malleable Iron Castings
ASTM A338	Malleable Iron Flanges, Pipe Fittings and Valve Parts for Railroad, Marine, and Other Heavy Duty Service at Temperatures up to 650 degrees F (345 degrees C)
ASTM E84/ NFPA 225/UL 723	Surface Burning Characteristics of Building Materials

NSF/ANSI 61	Drinking Water System Components – Health Effects
OSHA	Occupational Safety and Health Act
6 CRR-NY 599	Official Compilation Of Codes, Rules And Regulations Of The State Of New York Title; 6. Department Of Environmental Conservation; Chapter V. Resource Management Services; Subchapter E. Water Regulation; Part 599 Standards For New Or Modified Hazardous Substance Storage Facilities

1.03. SUBMITTALS

A. Provide in accordance with Sections 01300, Submittals; 01640, Equipment-General; and as supplemented herein. Submittals shall include, but not be limited to, the following:

1. Shop Drawings

a. Shop drawings shall indicate conformance to applicable ASTM/AWWA codes, pipe material, sizes, class, dimensions, joint type, features and accessories.

2. Layout/ Coordination Drawings - Show complete piping layout, including pumps, valves, materials, sizes, classes, locations, dimensions, supports, adapters, couplings, expansion joints, and hanger details. Joints shall be provided at all locations require by the Contract Documents, including all locations shown on the Contract Drawings. Piping layout/coordination drawings shall be coordinated with the equipment, ductwork, etc. to be provided by other Prime Contractors and be submitted in REVIT format separately from piping product shop drawings.

3. Welder Certifications - Provide current welder certificates of welders that are used in fabrication, erection, and installation. Each welder shall have a permanent identifying mark next to each weld.

4. Samples - Provide samples of piping when requested by Engineer.

5. Shop Test Results - Submit test results if shop testing is required.

6. Certification of equipment compliance.

7. Field Testing Results - Submit copies of pressure test reports.

1.04. PROJECT RECORD DOCUMENTS

A. Provide in accordance with Section 01700, Closeout and Record Documents, and as supplemented herein.

1. Submit record plans in CAD format including record location of pipe connections, valves, cleanouts, bends, tees, manholes, and rim and invert elevations.

2. Invert elevations shall be the measurement of the pipe invert at a point where the pipe enters or exits a structure.

3. Identify and locate on record drawings during construction the discovery of exposed uncharted existing utilities and services.

1.05. FIELD MEASUREMENTS

A. Prior to the start of construction, field verify measurements and elevations for existing conditions, piping, and equipment are as shown on the Contract Drawings. Notify Engineer of specific differences.

1.06. COORDINATION

A. Coordinate the work with Owner where operation of existing structures and treatment facilities are affected.

B. Coordinate the work with other prime contracts.

C. Coordinate preparation of layout/ coordination drawings with other Prime Contractors. General Contractor responsible to provide overall coordination drawings showing all trades equipment, ductwork, etc.

PART 2 PRODUCTS

2.01. GENERAL

A. All products included in this section shall conform to the requirements of the standard specifications referenced herein.

B. Pipe material, pipe class and pipe sizes shall be furnished and installed as listed in the pipe schedule herein and/or as shown on the Drawings.

C. Non-potable water, plant water and potable water piping materials shall be as specified in Section 15410, Plumbing Piping, unless otherwise noted on the Drawings.

2.02. DUCTILE IRON

A. Ductile iron pipe shall conform to AWWA C151/ANSI A21.51. Ductile iron pipe shall be rated for a minimum water pressure of 150 psi and be minimum Class 53.

B. Ductile iron pipe and fittings shall be double cement lined and seal coated inside and out in accordance with ANSI 21.4/AWWA C104.

C. Fittings shall conform to ANSI A21.10/AWWA C110.

D. Joints - All joints shall be Type I

1. Type I - Fittings shall be furnished with flanged joint. The type of joint shall meet the following applicable requirements:

a. Flanges shall be screw-on type flanges and the face of the flange shall be machined after installation of the flange onto the pipe.

b. No raised surface is allowable on cast iron flanges.

c. Flanges shall be 125-lb. ASA flanges rated for a maximum working pressure of 150 psi.

d. The fittings shall be of standard lengths given under the ANSI Specification B16.1, unless otherwise noted.

e. The pipe lengths shall be fabricated to meet the requirements of the Contract Drawings.

2.10. JOINTS IN ABOVEGROUND PIPING

A. Unless otherwise noted, joints for aboveground piping shall conform to the following specifications.

1. Flanged Joints

a. Shall be brought to exact alignment and all gaskets and bolts or studs inserted in their proper places.

b. Bolts or studs shall be uniformly tightened around the joints.

c. Where stud bolts are used, the bolts shall be uniformly centered in the connections and equal pressure applied to each nut on the stud.

d. Gaskets shall be ring type, minimum 1/8-inch thick.

1) Material shall be neoprene rubber for general liquid service and digester gas piping.

2) Material shall be Viton for general air service.

e. Flanges shall conform to AWWA Standard C115 (ANSI A21.15) with bolts provided in the size and number called for and in accordance with the American Standard with hexagonal nuts.

f. For bolt sizes and lengths, the “Handbook of Cast Iron Pipe” should be consulted.

g. Bolts and fasteners for exterior exposed or submerged flanged pipe fittings at process tanks shall be Type 316 stainless steel.

h. Bolts and fasteners for flanged pipe fittings located inside structures or otherwise protected shall be standard A36 steel. Steel bolts shall be field primed and painted with the same coating system the adjacent piping receives.

2.11. LININGS AND COATINGS

A. Inside of Pipe (Ductile Iron and Steel Pipe Only)

1. Pipe and fittings for all process and water lines shall be double cement lined and seal coated in accordance with ANSI 21.4/AWWA C104.

2. Air piping and fittings shall not be lined

B. Outside of Pipe

1. All interior ductile iron and steel pipe and fittings shall be factory primed and field coated per Section 09900, Painting.

2.12. IDENTIFICATION

A. Each pipe length and fitting shall be clearly marked with the following:

1. Manufacturer's name and trademark.

2. Nominal pipe size and class.

3. Material designation.

B. Contractor shall furnish and install pipe labels in accordance with Section 15076 – Piping and Equipment Identification.

2.13. HANGERS AND SUPPORTS

A. All piping shall be adequately supported and braced by means of adequate hangers, concrete piers, pipe supports, brackets, or otherwise as may be required by the location. Refer to Section 15140, Supports and Anchors.

2.14. SLEEVES AND CASTINGS

A. All piping passing through walls and floors shall be installed in sleeves or castings accurately located before concrete is poured, or placed in position during construction of masonry walls.

1. Sleeves passing through floors shall extend from the bottom of the floor to a point 3 inches above the finished floor, unless shown otherwise on the Contract Drawings.

2. Waterstop flanges are required on all sleeves located in floors or walls which are continually wet or under hydrostatic pressure on one or both sides of the floor or wall, where shown on the Contract Drawings, and on all sleeves penetrating walls of areas designed on the Contract Drawings as "gastight."

3. Sleeves shall be black steel pipe, or fabricated steel in accordance with details shown on the Contract Drawings.

4. Steel sleeves shall be fabricated of structural steel plate in accordance with the standards and procedures of AISC and AWS.

5. All steel wall and floor sleeves shall receive a commercial sandblast cleaning, and all surfaces shall be painted in accordance with Section 09900, Painting.

6. Castings shall be used on process piping through new walls and slabs where shown on the Contract Drawings. Castings size, wall thickness, joint type, and material shall match that of the adjacent piping, unless otherwise noted.

B. Refer to the standard details on the Contract Drawings for additional requirements and wall, floor, and deck sleeve details

C. If not shown on the Contract Drawings, the Contractor shall submit to the Engineer the details of the sleeves he proposes to install.

2.15. COUPLINGS AND ADAPTERS

A. General

1. Where alternative couplings are not shown on the Contract Drawings, flanged coupling adapters shall be used to join process piping to all pump flanges.

2. Adapters shall be restrained to process piping by the use of stainless steel tie rods. Refer to the Contract Drawings for additional tie rod requirements.

3. Couplings and/or adapters shall be provided by the Contractor for the alignment of similar types of pipe or connecting dissimilar pipe materials as required in accordance with the details shown on the Contract Drawings.

4. All new to existing connections shall be restrained in accordance with the detail shown on the Contract Drawings.

5. Unions shall be provided adjacent to all pumps, tanks, valves and other pieces of equipment where soldered, cement welded, or screwed joints are utilized.

6. Type 316 stainless steel bolts shall be used on all pipe adapters.

7. Where couplings and adapters are to be used they shall be installed in complete accordance with the manufacturer's recommendations

B. Flanged Coupling Adapters - Dresser Style 128W, Smith-Blair 913, or approved equal.

C. Dismantling Joints - Romac Style DJ400, Smith-Blair 975, or approved equal.

D. Mechanical Couplings - Dresser Style 38, Smith-Blair 411, or approved equal.

E. Reducer Couplings

1. Dresser Style 62, or approved equal.

2. When joining ductile iron pipe to existing reinforced concrete pipe, Contractor shall field verify O.D. of RCP and coordinate with coupling manufacturer for exact sizing. Contractor shall clean, grind, and smooth RCP for proper sealing of gasket.

2.16. STRUCTURAL EXPANSION JOINTS

A. Mechanical couplings shall be installed on all piping and conduit wherever such piping crosses a structural expansion joint.

1. A 1/8-inch gap shall be left between adjacent lengths of pipe with a Dresser Style 38; Smith-Blair 411; or approved equal coupling joining the piping.

2. Piping shall be supported by pipe supports each side of the mechanical coupling so that the coupling transmits no loads.

3. Contractor shall provide permanent restraints for all mechanical couplings installed on piping at structural expansion joints. Refer to the Contract Drawings for additional details.

4. All restraint hardware to be supplied and installed in accordance with manufacturer's recommendations

PART 3 EXECUTION

3.01. PIPING EXAMINATION

A. Verify that structures are complete enough to receive pipe.

B. All pipe or fittings which have been damaged in transit or which are obviously deformed or refinished in any way shall be rejected, marked and removed from the site of the work.

1. Any pipe or fitting which the Engineer suspects is improper for the job shall be temporarily rejected, marked and set aside for subsequent investigation to determine its conformity with the specifications.

2. All pipe fittings and specials shall be carefully inspected in the field before installation.

a. Cracked, broken, warped, out-of-round, damaged pipe joints including damaged pipe lining or coatings or specials, as determined by the Engineer, shall be culled out and not installed.

b. Such rejected pipe shall be clearly tagged in such manner as not to deface or damage it, and the pipe shall then be removed from the job site by the Contractor at his own expense.

3.02. PIPING INSTALLATION

A. All piping shall be installed by skilled workmen and in accordance with the best standard practice for piping installation.

1. Proper tools and appliances for the safe and convenient handling and installing of the pipe and fittings shall be used.

2. Great care shall be taken to prevent any pipe coating from being damaged on the inside of the pipe and fittings.

a. All pieces shall be carefully examined for defects and no piece shall be installed which is known to be defective.

3. If any defective pieces should be discovered after having been installed, it shall be removed and replaced with a sound one in a satisfactory manner by the Contractor and at his own expense.

4. Pipe and fittings shall be thoroughly cleaned before they are installed and shall be kept clean until they are accepted in the complete work.

5. All piping connections to equipment or tanks shall be provided with unions or coupling flanges located so that piping may be readily dismantled from the equipment or tank.

6. At certain applications, Dresser may also be used, subject to the Engineer's approval.

7. All piping shall be installed in such a manner that it will be free to expand and contract without injury to itself or surrounding structures or equipment.

8. All piping shall be erected to accurate lines and grades and shall be supported and braced against movement temporary or permanent.

B. Where process piping assemblies connect to equipment, valves or tanks, such piping shall be rendered compatible with the approved equipment, valve or tank installed and any necessary modifications to the original piping shall be shown in scaled layout on appropriate shop drawings submitted to the Engineer.

C. Piping connections to equipment shall be in accordance with the following:

1. Mating piping/equipment flanges shall be concentric to within a tolerance of 1/8 inch unbolted.

2. Mating flange faces shall be parallel to within a tolerance of 1/2 the normal gasket thickness or 1/8 inch, whichever is less, unbolted.

3. Flange face separation shall be no more than 1/8 inch beyond the normal gasket thickness or relaxed expansion joint length unbolted; nor less than the relaxed expansion joint length by more than 1/16 inch.

D. Piping assemblies under 4-inch size shall be essentially supported on walls and ceilings, unless otherwise shown on the Contract Drawings, being kept clear of openings and positioned above “headroom” space.

1. Where practical, such piping shall be run in neat clusters, plumb and level along walls, and parallel to overhead beams.

E. Install in accordance with the Contract Documents and the manufacturer’s written instructions.

F. Field verify all dimensions and elevations. Notify Engineer of specific differences.

G. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) for installation and testing.

H. Surface preparation and field painting shall be in accordance with Division 9 specifications.

I. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.

J. Isolate dissimilar metals by backpainting or with dielectric using stainless steel fasteners.

3.03. TESTING AND STARTUP

A. All process piping shall be tested in accordance with the procedures outlined below as required in the pipe schedule.

1. Where a section of pipeline has multiple uses, the pipe shall be tested at the highest pressure required.

a. Procedure A shall consist of a 15-minute test at 100 psi followed by a 3-hour test at 50 psi.

b. Procedure B shall consist of a 1-hour test at 150 psi followed by a 2-hour test at 100 psi.

c. Procedure C shall consist of a 30-minute test at 50 psi.

d. Procedure D shall consist of an exfiltration test; the pipe is filled with clear water to provide a head of at least 5 feet above the top of the pipe at the highest point of the pipeline 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 test period (for taking measurements) shall not be less than three hours.

e. Procedure E - Shall consist of a pressure test using air only.

1) All piping shall be tested at a pressure of at least two times the normal working pressure of the pipe, but in no case less than 50 psi in any of section of pipe being tested for a period of not less than 60 minutes.

2. When no test method for inside process pressure piping is specified in the pipe schedule, the following procedure shall be used.

a. All newly installed pipe or any valved section thereof shall be subjected to a hydrostatic pressure 50 percent in excess of the working pressure at the point of testing, but in no case less than 50 psi in any section of the pipe being tested, for a period of 2 hours.

b. A leakage test shall be conducted concurrently with the pressure test. The section tested shall be driptight with no signs of leakage.

3. Any leaks or defective pipe disclosed by any leakage and pressure tests shall be repaired or replaced and aforementioned tests repeated as often as necessary until conformance with the requirements.

4. All water for tests shall be furnished and disposed of by Contractor at his expense.

5. The source and quality of water which Contractor proposes to use in testing the lines shall be acceptable to Engineer.

6. All test water must be removed from the interior of all stainless steel pipe by draining, blowing, mopping, etc. Water must not be allowed to stand for long periods of time within stainless steel pipe.

(continued)

PROCESS PIPE SCHEDULE

Pipe No.	Identity	Predominant Size(s) (Inches)	Pipe Material	Schedule or Class	Joints	Test Procedure
	Wet Well Suction Piping	18, 16	DIP	Class 53	Flanged	50 psi for 2 hours
	Pump Suction and Discharge Piping	10, 8, 6	DIP	Class 53	Flanged	50 psi for 2 hours
	Discharge Header	14, 18, 24	DIP	Class 53	Flanged	50 psi for 2 hours
	Surge Relief	8	DIP	Class 53	Flanged	50 psi for 2 hours

END OF SECTION

SECTION 15076

PIPING AND EQUIPMENT IDENTIFICATION

PART 1 GENERAL

1.01. SUMMARY

A. Section Includes

1. Equipment labels.

2. Warning signs and labels.

3. Pipe labels.

4. Duct labels.

1.02. ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 PRODUCTS

2.01. EQUIPMENT LABELS

A. Plastic Labels for Equipment:

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. Brady Corporation.

b. Carlton Industries, LP.

c. Emedco.

d. Or approved equal.

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

3. Letter Color: Black.

4. Background Color: White.

5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

8. Fasteners: Stainless-steel rivets.

9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.02. WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Emedco.

2. National Marker Company.

3. Stranco, Inc.

4. Or approved equal

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

C. Letter Color: White.

D. Background Color: Red.

E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances.

H. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

I. Fasteners: Stainless-steel rivets.

J. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

K. Label Content: Include caution and warning information plus emergency notification instructions.

2.03. PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Kolbi Pipe Marker Co.

2. Emedco.

3. Carlton Industries, LP.

4. Or approved equal

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.

2. Lettering Size: Size letters according to ASME A13.1 for piping.

2.04. DUCT LABELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Carlton Industries, LP.

2. Emedco.

3. Seton Identification Products; a Brady Corporation company.

4. Or approved equal

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

C. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

F. Fasteners: Stainless-steel rivets.

G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

H. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.

PART 3 EXECUTION

3.01. PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02. EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.03. PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Section 09900 "Painting."

B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.

2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.

3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.

4. At access doors, manholes, and similar access points that permit view of concealed piping.

5. Near major equipment items and other points of origination and termination.

6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Pipe Label Color Schedule:

1. Effluent Water Piping: White letters on safety-grey background.

2. Sanitary Waste Piping: Black letters on safety-grey background.

3. Refrigerant Piping: White letters on a safety-purple background.

3.04. DUCT LABEL INSTALLATION

A. Install plastic-laminated self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:

1. Blue: For cold-air supply ducts.

2. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.

B. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

END OF SECTION

SECTION 15100

PROCESS VALVES

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Furnish, install, and test aboveground process valves complete with operators and all other required accessories in accordance with the Contract Documents.

1.02. REFERENCES

A. ANSI/AWWA C500 – Metal-Seated Gate Valves for Water Supply Service

B. ANSI/AWWA C507 – Ball Valves 6 inches through 48 inches

C. ANSI/AWWA C508 – Swing Check Valves for Waterworks Service 2 inches through 24 inches NPS

D. ANSI/AWWA C510 – Double Check Valve Backflow Prevention Assembly

E. ANSI/AWWA C512 - Air-Release, Air/Vacuum and Combination Air Valves for Waterworks

F. ANSI/AWWA C511 – Reduced Pressure Principle Backflow Prevention Assembly

G. ANSI/AWWA C520 – Knife Gate Valves 2 inches through 96 inches

H. ANSI/AWWA C542 – Electric Motor Actuators for Valves and Slide Gates

I. ANSI/AWWA C550 – Protective Interior Coatings for Valves and Hydrants

J. ASTM A126 – Gray Iron Castings

K. ASTM A48 – Gray Iron Castings for Valves, Flanges and Pipe Fittings

1.03. SUBMITTALS

A. Provide in accordance with Sections 01300, Submittals; 01640, Equipment-General; and as supplemented herein. Submittals shall include, but not be limited to, the following:

1. Shop Drawings

a. Shop drawings shall indicate types of valves, hydrants, appurtenances and actuators proposed for the project including conformance to ANSI/AWWA codes and related details for field assembly, operations and maintenance. Contractor shall identify the service (i.e., digested sludge, polymer, etc.) that the proposed equipment is intended for on the shop drawing.

b. For those valves with motors and actuators, submittals shall include dimensions and orientation of motors and actuators, size and quantity of conduit taps, complete wiring diagrams showing all provided options and inputs/outputs from the actuator assembly, input/output matrix of all available registers and corresponding system parameters that will be made available over the actuator's communication module.

c. Certification that all valve components that will come in contact with the liquid are fully compatible with the liquid inside of the valve and outside the valve.

2. Shop Test Results - Submit test results if shop testing is required.

3. Certification of equipment compliance.

4. Field Testing Results - Submit test results if field testing is required.

5. Operations and maintenance manuals.

6. Valve Directory

a. A preliminary valve directory shall be submitted by the Contractor before construction begins. The Contractor is responsible for maintaining an accurate record of all valves installed during the project.

b. A final valve directory shall be provided listing all valve numbers, the valve function, and location which corresponds to the valve tags. The directory shall be typewritten and framed with a glass cover and delivered to the Owner after inspection and approval by the Engineer.

PART 2 PRODUCTS

2.01. GENERAL

A. The design working pressure shall be 200 psig for valves 12 inches NPS in diameter and smaller, and 150 psig for valves 16 inches NPS in diameter and larger.

B. All valves shall be compatible with all the materials the valves shall be exposed to.

C. All valves shall have the manufacturer's name monogrammed or initialed by the manufacturer thereon and shall be identified by catalog numbers.

D. Valve size, type of valve, joint type, class, lining, coatings shall be installed as listed herein or as shown on the Contract Drawings.

E. Valves shall be of standard manufacturer and of highest quality, both as to material and workmanship, conforming to the latest edition of AWWA standards specified.

F. All valves shall be provided with flanged or screwed ends as described herein or shown on the Contract Drawings.

G. All surface forming joints or bearing surfaces shall be machined to a perfect fit.

H. All disc and seat rings shall be carefully and thoroughly secured in place with the iron castings machined where the rings are bare and the backs of the rings machined all over. After the rings have been fastened securely in place, the front shall be machined all over to a perfectly true and smooth bearing surface.

I. All valves with non-rising stems shall have valve position indicators.

J. Valves shall open counterclockwise (left) unless otherwise specified.

K. Ferrous metal valves shall be painted in accordance with Section 09900, Painting.

L. All new motorized actuators on motorized valves shall be of the same manufacturer.

2.02. RESILIENT SEATED GATE VALVES

A. Gate valves 2 inches and smaller shall be bronze gate valves with rising stem, double wedge disc, screwed bonnet, screwed ends, 125-lb. rating and shall be repackable under pressure in full open position.

B. All gate valves 2 inches and smaller shall be Stockham Figure 107; Lunkenheimer Figure 2127; or approved equal.

C. All other gate valves shall conform to the latest AWWA Standard and shall be suitable for wastewater applications. Except where otherwise indicated on the Contract Drawings.

D. The valves shall have a cast iron body, bonnet and wedge. The wedge shall be totally encapsulated with rubber.

E. The sealing rubber shall be permanently bonded to the wedge to meet ASTM tests for rubber metal bond ATSM D249.

F. Valves shall be supplied with O-Ring seals at all joints.

G. The valves shall be non-rising (NRS), unless otherwise noted in the Contract Drawings.

H. Stems for NRS assemblies shall be cast bronze with integral collars in full compliance with AWWA. OS&Y (rising stems) shall be of bronze. All stems shall operate with bronze stem nuts, independent of stem (in NRS valves). NRS stems shall have 2 O-Rings located above thrust collar and O-Ring below. All stem O-Rings shall be replaceable with valve fully opened and subjected to full pressure. The NRS stems shall also have 2 low torque thrust bearings located above and below stem collar to reduce friction during operation.

I. Waterway shall be smooth, unobstructed and free of all pockets, cavities and depressions in the seat area. Valves shall accept a full size tapping cutter.

J. The body, bonnet and stuffing plate shall be coated with fusion bonded epoxy, both interior and exterior on body and bonnet. Epoxy shall be applied in accordance with AWWA C550.

K. Each valve shall have a maker's name, pressure rating, and year in which it was manufactured cast in the body. Prior to shipment from the factory, each valve shall be tested by hydrostatic pressure equal to requirements of AWWA.

L. All interior gate valves shall be equipped with handwheel or chain and wheel operators unless otherwise specified.

1. Handwheel or chain and wheel operators shall be replaceable with 2-inch operating nuts without replacing the valve stem or removing the bevel gears.

M. Gate valves shall be designed to be leak-tight with full pressure on either face with no pressure on the opposite face.

N. All internal parts shall be accessible without removing the body from the line.

O. Valves shall have all brass components cast and assembled in the USA and shall be manufactured by Kennedy Valve Company or approved equal.

2.03. KNIFE GATE VALVES

A. Provide knife gate valves where indicated on the Contract Drawings.

B. Knife Gate valves shall be cast 316 stainless steel and bidirectional. Any body or gate material other than 316 Stainless Steel will be rejected.

C. Knife Gates shall meet the American Iron and Steel Act without material substitution.

D. Knife Gates shall be made in America.

E. Port area shall be 100% of nominal pipe area at all points of the valve.

F. Gate edges shall be machined, finished, and rounded. The gate faces shall be finish ground.

G. Valves shall be of a perimeter seat design and the seat shall provide guiding for the gate.

H. General:

1. Knife Gate valves shall be one piece cast 316 Stainless Steel.

2. Valves shall be 150 psi (1030 kPa) for 2-28” (50-700mm) and 100 psi (690 kPa) available for 30” and 36” (750mm and 900mm).

3. Cold Working Pressure valve rating shall meet or exceed MSS SP-81.

4. Face-to-face dimension shall meet MSS SP-81 for knife gate valves.

5. Exclusive Premium Packing System shall fit a rounded machined packing chamber. The Exclusive Premium Packing System shall consist of multiple layers of packing with anti-extrusion guides. The packing gland shall match the valve body or (specify).

6. The fasteners shall be stainless steel.

7. Valve inside port diameter shall be equal to ANSI B36.10 STD pipe inside diameter.

8. End Connection - Flanged, Drilled to ASME B16.1 Class125/150

a. Raised faces shall be full width per ASME B16.20 standards for spiral-wound gaskets.

9. Resilient Seat shall be capable of bubble-tight bi-directional shutoff to the full pressure rating of the valve in both directions and provide shutoff on dead end service.

10. Resilient seat shall be a one-piece rubber molded seat with seat pucks at the top and an encapsulated full metal reinforcement insert in 316 stainless steel for rigidity.

11. Seat pucks shall be locked into a machined pocket in the bottom of the packing chamber and not interfere with the integrity of the packing chamber.

12. The perimeter seat shall be locked into the valve body in a dovetail groove.

13. All Actuators will be mounted, adjusted and tested at the valve manufacturers facility. This shall be evidenced by witness test of the entire assembly, at the engineer's discretion, at the manufacturer's facility.

I. Materials of Construction:

1. Body and gate: One piece cast 316 Stainless Steel.

a. Material substitutions are not acceptable.

2. Gate:

a. 316 Stainless Steel

b. Material substitutions are not acceptable.

3. Packing: PTFE Braided Packing to 500° F. (260° C.); (pH Range 0-14)

4. Seat: Chloroprene, BUNA or EPDM to 250° F. (122° C.)

J. Actuators:

1. Manually actuated valves shall have handwheel actuators. The manual operated handwheel actuator yoke shall be one piece 304 stainless steel. The yoke sleeve shall be aluminum

K. Knife Gate Valves shall be manufactured by DeZurik Model KGC-ES, or approved equal.

2.04. PLUG VALVES

A. Plug Valves shall be rectangular port, resilient seated and body and bonnet shall be of the same material.

B. Port area shall be 100% of nominal pipe area at all points of the valve.

C. General:

1. All plug valves shall be of rectangular port, eccentric type unless otherwise specified.

2. Exposed valves shall have flanged ends.

3. Design Working Pressures:

a. Valves 12 inch and Smaller: 175 psig

b. Valves 14 inch through 72 inch: 150 psig

4. Valves shall provide drip tight bidirectional shut off at the design working pressure, operating pressures and test pressures.

5. The plug shall have a cylindrical seating surface eccentrically offset from the center of the shaft. Plug shall not contact the seat until at least 90% closed:

a. The interface between the plug face and body seat, with the plug in the closed position, shall be externally adjustable in the field with the valve in the line under pressure.

6. Round Ports are not acceptable.

7. Spherical Plugs are not acceptable.

8. All Actuators will be mounted, adjusted and tested at the valve manufacturers facility. This shall be evidenced by witness test of the entire assembly, at the engineer's discretion, at the manufacturer's facility.

D. Materials of Construction:

1. Body (including bonnet): Cast or Ductile Iron ASTM A 536, Grade 65-45-12. Material substitutions are not acceptable.

2. Plug:

a. Core: Cast or Ductile Iron ASTM A 536, Gr. 65-45-12.

b. Plug Facing: Chloroprene (CR).

c. For valves up to 8 in. plugs shall be fully encapsulated with rubber. Valves over 8 in. shall have plug seating surface fully encapsulated with rubber.

d. Plug resilient facing shall have a rubber to metal bond strength (pull) of 250 psi (ASTM D 429 Method A) and a minimum bond strength (peel) of 75 psi (ASTM D 429 Method B).

e. To ensure the quality of the Chloroprene, the rubber compound shall be manufactured, applied to the plug, and vulcanized per the manufacturer’s standards at the manufacturer’s plant.

f. Certifications will be provided to and reviewed by the engineer as a part of the submittal package.

g. Any deviations will require witness test at the manufacturer's facility of rubber manufacturing process.

3. Stem Bearings: Sintered, oil impregnated permanently lubricated of type 316 stainless steel ASTM A743 Grade CF8M through 36”. In valves larger than 36”, the upper and lower plug journals shall be fitted with ASTM A240 type 316 stainless sleeves with body bearings of ASTM B30, Alloy C95400 aluminum bronze.

4. Seal/Packing: Acrylonitrile-Butadiene (NBR) multiple V-ring type, with a packing gland follower.

a. Packing shall be able to be replaced without disassembly of the valve

b. Packing shall be adjustable by the use of adjustable nuts on the packing gland

c. Self-adjusting packing is not acceptable

d. Packing adjustment using removable shims not acceptable.

e. Video of packing replacement procedure verifying no valve or actuator disassembly is required shall be provided with submittal package to qualify as an or equal.

5. Seat: 1/8” thick welded overlay of not less than 95% pure nickel.

   a. Seat shall be at least 1/2” wide, 1/8” thick through entire width and raised.

   b. The raised surface shall be completely covered with nickel to insure that the resilient plug face contacts only the nickel seat.

6. Packing gland: Cast Iron ASTM A 126 Class B.

E. Actuators:

1. For buried applications actuators shall be fully sealed, buried/submerged rated worm gear type. Gear shall terminate in a 2” nut.

   a. Extension stems, floor box and valve box shall be by contractor as specified in contract documents.

2. For non-buried applications actuators shall be manual with worm gear sized for 80 lb rim pull maximum.

F. Shop Testing:

1. Performance Tests:

   a. To demonstrate that the complete assembly is workable, each valve (with the actuator mounted directly on the valve or as required) shall be shop operated three times from the fully closed to the fully opened position and the reverse under a no-flow condition.

2. Leakage Tests:

   a. Each valve shall be shop tested for leaks in the closed position

   b. Valves shall be given a leakage test at the design working and operating pressures. During the test, the valves shall be drip tight. The test duration shall be at least 5 minutes for valves up to 20 inches and 10 minutes for valves 20 inches and larger. The tests shall be repeated with pressure in the opposite direction.

3. Hydrostatic Tests:

   a. All valve bodies shall be subjected to an internal hydrostatic pressure equivalent to twice the rated pressure.

   b. During the hydrostatic test, there shall be no leakage through the metal, end joints, or shaft seal, nor shall any part be permanently deformed.

   c. The duration of the hydrostatic test shall be sufficient to allow visual examination for leakage. Test duration shall be at least 1 min. for valves 8 in. and smaller, 3 min. for valves 10 in. through 20 in. and 10 min. for valves 20 in. and larger.

G. Plug valves shall be model PEF as manufactured by DeZurik, or approved equal.

2.05. SEWAGE SURGE RELIEF VALVE

A. The Angle Surge Relief Valve shall be heavily constructed cast iron body and ductile iron cover, to withstand severe shock conditions. The body shape shall be 90° angle pattern to permit side or downward discharge.

B. Valve shall meet the American Iron and Steel Act without material substitution.

C. General:

a. The cover shall provide an air gap between the surge valve and the hydraulic cylinder. The valve stem shall be connected to the hydraulic cylinder by means of a self-aligning vertical coupler to ensure smooth positive opening, without binding, during opening of the valve.

b. The hydraulic cylinder shall be removable from the valve without dismantling or removing the valve from the line. Closing speed shall be externally adjustable by means of a coded micrometer control valve.

c. The valve disc shall be normally closed against the system operating pressure by means of a spring. When the system pressure exceeds the normal operating pressure by 10%, the Angle Surge Relief Valve shall open immediately to relieve the pressure surge and close slowly as the system pressure returns back to normal.

d. The hydraulic cylinder shall be capped on both ends (totally enclosed) to prevent dirt or dust from fouling up the cylinder operation. It shall be fitted with an atmospheric oil reservoir.

e. The relief pressure shall be set at the factory, but additional adjustments can be made in the field by increasing or decreasing the tension on the externally adjustable springs. Specify Pressure Class and relief pressure setting per Surge Analysis Report.

f. Valve exterior to be painted with Universal Metal Primer as accepted by the FDA for use in contact with Potable Water.

D. Materials of construction:

a. Body: Cast Iron ASTM A-26 Gr.B.

b. Body Seat Ring: Aluminum Bronze, ASTM B-48.

c. Cover: Ductile Iron ASTM.

d. Disc Seat: Buna-N A536.

e. Disc: Steel, ASTM A36.

f. Heavy Duty Hydraulic Cylinder: Steel.

E. Exterior Coating:

a. All valves shall be externally coated. The steel, cast-iron and ductile-iron surfaces, except machined surfaces, shall be epoxy coated in accordance with AWWA C550.

F. Shop Testing:

a. Performance Tests:

1) To demonstrate that the complete assembly is workable, each valve (with the actuator mounted directly on the valve) shall be shop operated to demonstrate surge relief valve operation at engineer specified relief pressure setting.

G. Leakage tests:

a. Each valve shall be shop tested for leaks in accordance with AWWA.

H. Two Year Warranty shall be provided for all valves.

I. The valve shall be DeZurik SRA-300A-JP, or approved equal.

2.06. SWING CHECK VALVES - CUSHIONED

A. Check valves shall be of high performance type. Full flow shall be achieved with valve opening a maximum of 25 deg. Valve shall meet the American Iron and Steel Act without material substitution, body and cover shall be of the same material.

B. General:

1. Check valves shall be with external lever and adjustable weight. They shall comply fully with AWWA C508 and be designed for use in wastewater service.

2. Design Working Pressure: 250 psi.

3. Valve shall have a Bottom Mounted Buffer permitting free opening, but positive non-slam closure of the disc.

4. Side mounted oil or air cushions are not acceptable.

5. End connections shall be flat faced, flanged per ASME/ANSI 125/150 lb. standard.

6. Valves 6” and larger shall have a drain plug located on the bottom of the valve.

7. The Bottom Mounted Buffer shall make contact with the disc during the final 10% of closure to control the disc until shut-off in a manner to prevent slam and water hammer.

a. Oil Cushion is to be field adjustable by means of two color-coded micrometer type control valves.

b. Oil Cushion assembly shall have a pneumatic dashpot to assist deployment of piston when valve is opened.

c. Control valve to have a set screw lock to secure final setting accuracy.

d. Oil Cushions that are shaft mounted are not acceptable.

C. Materials of Construction:

1. Body (including cover): Ductile Iron ASTM A 536, Grade 65-45-12. Material substitutions are not acceptable.

2. Body Seat: 316 stainless steel per ASTM A743, Grade CF-8M.

3. Seat shall be locked into place with stainless steel screws. Non mechanical means of retaining seat are not acceptable.

4. All external fasteners: Stainless steel.

5. Disc and Disc Arms: ASTM A536 ductile iron.

   a. The disc shall be attached to the disc arm with a double clevis hinge to assure self-leveling and even load distribution upon closure, minimizing seat wear.

   b. Disc shall have an independent adjustable full open disc stop. The disc arm, valve body or cover is not to be used as the disc stop.

   c. Disc seat shall be nitrile butadiene (NBR) and field replaceable without the use of special tools.

   d. Material substitutions are not acceptable.

6. Pivot Shaft: ASTM 564 Type 630, 17-4PH stainless steel protruding through both sides of the body with a lever & weight.

   a. The pivot shaft shall have an integral retainer to prevent axial shaft movement.

   b. The pivot shaft shall have O-rings seals on both sides of the shaft.

   c. Braided type packing is not acceptable.

   d. Lever & Spring or Lever & Weight Lever arm and adjustable counterweight: Ductile iron A536 grade 65-45-12.

7. Oil Cushion: 316 stainless steel per ASTM A240.

   a. Buffer Rod: 303 stainless steel per ASTM A582.

   b. Hydraulic hoses are to be S.A.E. certified.

8. Exterior Coating: All valves shall be externally and internally coated with fusion bonded epoxy.

D. Check valves shall be DeZURIK CVS-6000A, or approved equal.

2.07. STAINLESS STEEL BALL VALVES

A. Stainless steel ball valves shall be provided on lines that use stainless steel piping and as otherwise indicated on the Contract Drawings.

B. Stainless steel ball valves shall have flanged end connections above 2 inches and shall be rated for 150-lb. service, unless otherwise noted.

C. Valves shall be lever-operated with stainless steel levers and lockout devices.

D. Valves shall be Type 304 stainless steel with PTFE ball seats, packing and stem steel.

E. Manufacturer – Apollo, Marpac, Ladish, Sharpe, A-T Controls, Nibco, FlowServe, TrueLine, or approved equal.

1. Or approved equal manufacturers shall have demonstrated experience in the manufacture of valves in municipal water/wastewater industry for at least five years.

2.08. AIR/ VACUUM AND COMBINATION AIR VALVES

A. Air/ vacuum valves and combination air valves shall be installed where shown on the Contract Drawings.

B. Valves shall be designed for operation on sewage without spillage or spurting.

C. Valves shall meet the following:

1. Combination valves sizes 4 in. through 6 in. shall have bolted flanged inlets and NPT outlets. Flanges shall be in accordance with ANSI B16.1 for Class 125 iron flanges.

2. Air/Vacuum valves sizes 3 in. and smaller shall have full size NPT inlets and outlets equal to the nominal valve size with a 2 in. (50 mm) inlet on 1 in. (25 mm) valves. The body inlet connection shall be hexagonal for a wrench connection. The valve body shall have 2” NPT cleanout and 1” NPT drain connections on the side of the casting.

3. Air/Vacuum valves sizes 4 in. and larger shall have bolted flange inlets with NPT outlets. Flanges shall be in accordance with ANSI B16.1 for Class 125 iron flanges.

4. All valves shall have three additional NPT connections for the addition of backwash accessories.

D. Wastewater combination air valves shall be automatic float operated valves designed to exhaust large quantities of air during the filling of a piping system and close upon liquid entry. The valve shall open during draining or if a negative pressure occurs. The valve shall also release accumulated air from a piping system while the system is in operation and under pressure. The valve shall perform the functions of both Wastewater Air Release and Wastewater Air/Vacuum Valves.

E. Wastewater Air/Vacuum valves shall be fully automatic float operated valves designed to exhaust large quantities of air during the filling of a piping system and close upon liquid entry. The valve shall re-open during draining or if a negative pressure occurs.

F. Body, cover and baffle of valves shall be cast iron; floats, guide shaft, bushings and plug shall be constructed of stainless steel; seats of Buna-N; and miscellaneous internal parts of stainless steel. Non-metallic guides and bushings are not acceptable.

G. Valves shall contain backflushing attachments with quick connection, and hose to extend connection to manhole cover.

H. Valves shall full seat and seal at a minimum operating pressure of 3 psi and operational up to 150 psi.

I. The exterior of the valve shall be coated with a universal alkyd primer.

J. Air and vacuum valves shall be as manufactured by Val-matic, or approved equal, and shall be the following, or approved equal, as specified on the Contract Drawings:

1. 4-inch Dual Body Combination Valves, Model #49A/304

2. 2-inch Air/Vacuum Valves, Model #302A

3. 3-inch Air/Vacuum Valves, Model #303A

4. 4-inch Air/Vacuum Valves, Model #304

2.09. PRESSURE GAUGES

A. Liquid Service

1. Pressure gauges shall be of the oil filled, bourdon tube type with 4-1/2-inch diameter and diaphragm seals.

2. Case ring shall be black epoxy coated aluminum, bourdon tube shall be phosphor bronze with a brass tip and window shall be glass unless otherwise specified.

3. Pressure gauges shall be stem mounted where shown on the Contract Drawings.

4. Pressure gauges shall be calibrated to read zero at atmospheric pressure.

5. Suction (vacuum) gauges shall be of the compound type to indicate both pressure and vacuum; they shall be calibrated to read 25 feet of water above and below zero.

6. Discharge (pressure) gauges shall be calibrated to read from 0 feet to a minimum of 5 feet of water pressure above the maximum operating pressure for the associated process pipe.

7. All pressure gauges shall have continuous duty, clamped Teflon diaphragm seals. Pressure gauges and diaphragm seals shall be by same manufacturer and shall be shipped as complete units, factory filled with silicone fluid.

a. Each diaphragm seal shall have Type 316 stainless steel upper and lower housings. The lower housing shall be a threaded connection.

b. Each pressure gauge and diaphragm seal unit shall be connected with the necessary brass pipe fittings and a brass stopcock.

8. All pressure gauges furnished under this section shall be supplied by the same manufacturer. Pressure gauge manufacturer shall be Ashcroft, U.S. Gauge, or approved equal.

2.10. HANDWHEEL OPERATORS

A. Valves specified with handwheel operators shall have the proper size handwheel to provide an effortless operation.

B. Handwheels shall be made of bronze or cast iron and shall be properly secured to the valve stem to prevent displacement during use.

2.11. WRENCH OPERATORS

A. Wrench for wrench-operated valves located above ground shall be of bronze or cast iron, and shall be of suitable size and length to facilitate an effortless operation. One wrench shall be provided for each valve on the project requiring wrench operation.

2.12. CHAIN AND WHEEL OPERATORS

A. All valves located with center of shaft 6 feet or higher from the operating floor shall be equipped with chainwheel operators.

B. The chainwheel operators shall have a straight or a beveled gear reducer-type operator depending on the type recommended by the manufacturer.

C. The length of the operating chain shall extend to 4 feet 0 inches above the operating floor.

D. Chain in wet or corrosive areas shall be stainless steel.

2.13. VALVE TAGS AND DIRECTORY

A. Provide valve tags for all valves. Tag/identification shall be coordinated with Engineer.

B. Tags shall be made from a plastic laminate of heavy plastic with a brass eyelet in the corner and shall be engraved or printed with the valve number and fluid in the pipe.

C. Tags shall be fastened to each valve with a brass chain.

D. Tags to be made by Seton Name Plate Company, New Haven, CT; W.H. Brady Company; or approved equal.

E. A preliminary valve directory shall be submitted by the Contractor before construction begins. The Contractor is responsible for maintaining an accurate record of all valves installed during the project.

F. A final valve directory shall be provided listing all valve numbers, the valve function, and location which corresponds to the valve tags. The directory shall be typewritten and framed with a glass cover and delivered to the Owner after inspection and approval by the Engineer.

2.14. MOTORS AND DRIVES

A. Unless otherwise specified, motors for electric operators shall comply with requirements specified in Section 15170, Motors.

B. Motors and drives shall be furnished by the equipment supplier and shall be designed specifically for use with the equipment provided.

C. Motors for electric operators shall be totally enclosed, with all leads terminating within the limit switch compartment.

D. All motors for electric operators shall be AC type. DC motors will not be accepted.

2.15. ELECTRIC VALVE ACTUATORS

A. General

1. The actuator shall consist of an electric motor, worm gear reduction, absolute position encoder, electronic torque sensor, mechanical or solid state motor controller, electronic control, protection, and monitoring package, manual override handwheel, valve interface bushing, 32-character graphical LCD (Liquid Crystal Display), and local control switches all contained in an enclosure.

2. Actuator design life shall be at least one million drive sleeve turns.

3. The actuator shall include a removeable drive sleeve for machining per valve or gear box requirements.

4. Shall be furnished with AWWA gear box and be direct mount.

5. The shop coating of the operator shall include rust-inhibitive primer compatible with the final field coat of epoxy paint.

6. Valve operators shall be sized for the closing and seating requirements of the valves they are controlling and the type of service and shall function under the operating conditions as specified.

7. Provide couplings and mountings between valve operators and valves as necessary for valve operation.

8. Electric actuators shall comply with the latest revision of AWWA Standard C540.

9. The power transmission shall be completely bearing-supported and consist of a hardened alloy steel worm and bronze allow worm gear, oil-bath using synthetic oil designed specifically for extreme pressure worm and worm gear transmission service.

B. Operators

1. Operator shall include motor, unit gearing, limit switch gearing, limit switches, torque switches, declutch lever as a self-contained unit, and a manual handwheel operator.

2. For actuators installed in an unclassified area, operator housing shall be cast aluminum or cast iron, NEMA 4X, watertight enclosure unless otherwise specified.

3. For actuators installed in hazardous rated areas, operator housing shall be cast aluminum or cast iron NEMA 7 watertight enclosure, unless otherwise specified.

4. Operator shall include integral control station to contain a local/remote selector switch with pushbutton open-close operation in the manual mode, valve position indicator lights (open-closed), and valve position indicator.

5. A seized or inoperable motor shall not prevent manual operation. Return from manual to electric operation will be automatic upon motor operation.

6. Valves with electric actuators shall also be provided with a metallic handwheel for manual operation.

C. Motors

1. All motors and drives shall be in full accordance with Section 15170, Motors, and the Contract Drawings.

2. Motor housing shall be totally enclosed, non-ventilated (TENV).

3. Motor shall be specifically designed for valve-actuating service and shall operate on 460-volt, three-phase, 60 Hz power supply with Class F insulation and a thermistor embedded within the motor windings to prevent damage due to overload. The motor shall be easily removed through the use of a plug-in connector and shaft coupling.

4. Shall be of sufficient size to open and close the valve in the times specified and at the valve's maximum operating conditions.

5. Bearings shall be anti-friction type, permanently lubricated.

6. Shall be independent of gearing to allow for gear changes.

D. Ratings

1. Operators designated as "modulating" shall be rated for minimum 1,200 starts per hour and shall have opening and closing times of 2 minutes (120 seconds), minimum.

2. Operators designated as "standard" shall be rated for 60 starts per hour and shall have opening and closing times of 1 minute (60 seconds), unless otherwise specified.

3. The actuator's torque output shall be measured electronically. Each actuator shall be torque tested to prove the required torque requirements of the valves are met with a minimum of a 35% margin of safety. A copy of the torque test data shall be provided with each actuator at time of shipment.

4. As a minimum, all operators shall be rated for the torque requirements of the valves on which they are mounted. Submit calculations to substantiate operator sizing.

E. Valve Position/Actuator Status Indication

1. Valve position shall be sensed by a 12-bit absolute position encoder with redundant position sensing circuits design for Built-In-Self-Test. Each of the position sensing circuits shall be redundant permitting up to 50% fault tolerance before the position in incorrectly safe shutdown of the actuator.

2. Open and closed positions shall be stored in permanent, nonvolatile memory.

3. The absolute encoder will be capable of resolving down to 0.1% of output shaft position over 360 degrees.

4. The actuator must provide a local display of the position of the valve, even when the power supply is not present through a valve position indication dial.

5. In the event of a power loss or failure, the open/close position contacts must continue to be able to supply remote position feedback and maintain interlock capabilities.

6. The actuator shall be able to ensure correct remote indication should the actuator be moved manually when the power supply is interrupted.

7. The position of the actuator and valve must be updated contemporaneously, even when the power supply is not present.

F. The control module shall include power and logic circuit boards, control transformer, and at least two primary power protection fuses, all mounted to a steel plate and attached in the control compartment with captive screws. The use of O rings or other such devices to secure the control boards shall not be permitted. The module shall be easily removed through the use of plug-in connectors. The module shall also include a reversing contactor, local control switches, 32-character graphical LCD, and LED indicators. It shall also be Bluetooth ready. All internal wiring shall be flame resistant. Voltage shall be selectable via a jumper included on the power board.

G. Electric valve actuators shall be as manufactured by Rotork, Limitorque, or approved equal.

2.16. FABRICATION REQUIREMENTS

A. Shop coat per manufacturer's standard finish system and color.

B. All bolts, nuts, washers, and other fasteners shall be Type 304 stainless steel unless otherwise noted.

C. Welds shall be continuous unless noted otherwise.

D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

2.14. CUSTOM FABRICATED STEEL FITTINGS

A. Fabricated steel fittings for the surge valve connection in pump discharge header shall be a custom fabricated steel tee 24" x 12".

B. Design calculations, shop drawings (details), and shop tests shall be submitted.

C. Fittings shall be fabricated to 250 psi rating in accordance with ANSI/AWWA C200 and AWWA M11.

D. All fittings shall be hydrostatically shop tested prior to shipment. Testing on steel fittings shall be done at 100 psi for two hours. Refer to Section 15060, Aboveground Process Piping, for pipe testing requirements.

E. Fittings shall be fabricated with flange connection to connect to Ductile Iron Pipe.

a. Insulating joints shall be provided when connecting to DIP; electrical resistance test shall be performed after insulation; resistance shall at least be 10,000 ohms; results shall be submitted to the Engineer.

PART 3 EXECUTION

3.01. EQUIPMENT INSTALLATION

A. Install in accordance with the Contract Documents and the manufacturer's written instructions.

B. No modifications to equipment shall be made without the written consent of the manufacturer and approval of Engineer.

C. Field verify all dimensions and elevations. Notify Engineer of specific differences.

D. Verify that structures are complete and ready to receive work.

E. All valves, deck hydrants and appurtenances shall be carefully inspected in the field before installation.

1. Cracked, broken, warped, out-of-round, damaged joints, including damaged linings or coatings, or otherwise defective valves, hydrants and stops, as determined by the Engineer, shall be culled out and not installed.

2. Rejected material shall be clearly tagged in such manner as not to deface or damage it, and the material shall then be removed from the job site by the Contractor at his own expense.

F. For tapping sleeve and valve connections, the Contractor, prior to making any connections, shall verify the material and outside diameter of existing water main.

G. Contractor shall have on the job site all the proper tools, gauges, pipe cutters, lubricants, etc., to properly install valves, deck hydrants, etc.

H. Contractor shall verify all valve positions and locations before installation.

I. Valves, backflow preventers and appurtenances shall be installed at the elevations and locations shown on the Contract Drawings.

J. The Contractor shall furnish slings, straps, and/or approved devices to provide satisfactory support of the valves or hydrants when lifted. Transportation from storage areas to the work area shall be restricted to operations which can cause no damage to the coating or lining or castings

K. The valves shall not be dropped from trucks onto the ground or into the trench.

L. All valves shall be installed in accordance with the specifications for the pipe to which they are to be connected and as previously described for individual types of valves.

M. Joints of valves shall be made up in accordance with the Contract Drawings and/or as described under the appropriate pipe joint descriptions found in other sections of these specifications.

N. The valves shall be so located that they are accessible for operating purposes and shall bear no stresses due to loads from the adjacent pipe.

O. All valves shall be inspected before installation, and they shall be cleaned and well lubricated before being installed in the line.

P. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) for installation and testing.

Q. Surface preparation and field painting shall be in accordance with Division 9 specifications.

R. All bolts, nuts, washers, and other fasteners shall be Type 304 stainless steel unless otherwise noted.

S. Anchor rods (bolts) shall be Type 304 SS HILTI-style adhesive anchors.

T. Backpaint aluminum in contact with painted or galvanized steel or concrete with 5 mils of Tnemec Series N69-Gray, Hi-Build Epoxoline or DuPont 25P Epoxy.

U. Isolate dissimilar metals by backpainting or with dielectric using stainless steel fasteners

3.02. TESTING AND STARTUP

A. Testing and startup shall be performed in accordance with Section 01660, Testing and Startup, and as specified herein unless otherwise noted.

B. All testing shall be done in the presence of the Engineer and the equipment manufacturer or their approved representative.

C. Valves and appurtenances installed in piping systems shall be pressure tested under the same conditions required for the adjacent piping. Refer to Section 15060, Aboveground Process Piping, for pipe testing requirements.

END OF SECTION

SECTION 15110

VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.01. SUMMARY

A. Section Includes

1. Brass ball valves.

2. Bronze ball valves.

3. Bronze swing check valves

1.02. ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 Annex G.

PART 2 PRODUCTS

2.01. GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance

1. ASME B1.20.1 for threads for threaded end valves.

2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

3. ASME B16.18 for solder-joint connections.

4. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 Annex G for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types

1. Hand lever: For quarter-turn valves smaller than NPS 4.

2.02. BRASS BALL VALVES

A. Brass Ball Valves, Two-Piece with Full Port and Brass Trim

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. Jomar Valve

b. NIBCO INC.

c. WATTS.

2. Description

a. Standard: MSS SP-110.

b. CWP Rating: 600 psig.

c. Body Design: Two piece.

d. Body Material: Forged brass.

e. Ends: Threaded and soldered.

f. Seats: PTFE.

g. Stem: Brass.

h. Ball: Chrome-plated brass.

i. Port: Full.

2.03. BRONZE BALL VALVES

A. Bronze Ball Valves, Two-Piece with Full Port, and Bronze or Brass Trim

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. NIBCO INC.

b. WATTS.

c. Zurn Industries, LLC.

2. Description

a. Standard: MSS SP-110.

b. CWP Rating: 600 psig.

c. Body Design: Two piece.

d. Body Material: Bronze.

e. Ends: Threaded and soldered.

f. Seats: PTFE.

g. Stem: Bronze or brass.

h. Ball: Chrome-plated brass.

i. Port: Full.

2.04. BRONZE SWING CHECK VALVES

A. Bronze Swing Check Valves with Bronze Disc, Class 125:

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. Apollo Valves; a part of Alberts Integrated Piping Systems.

b. Milwaukee Valve Company.

c. NIBCO INC.

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 or soldered. See valve schedule articles.

f. Disc: Bronze.

PART 3 EXECUTION

3.01. 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.

3.02. GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves 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 Steel Piping, NPS 2 and Smaller: Threaded ends.

3.03. DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.

2. Brass ball valves, two-piece with full port and brass trim.

3. Bronze ball valves, two-piece with full port and bronze or brass trim.

END OF SECTION

SECTION 15111

CONTROL VALVES

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.

1.02. SUMMARY

A. Section includes control valves.

1.03. DEFINITIONS

A. Cv: Design valve coefficient.

B. DDC: Direct-digital control.

C. NBR: Nitrile butadiene rubber.

D. PTFE: Polytetrafluoroethylene

E. RMS: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.

1.04. ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.

2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.

3. Product description with complete technical data, performance curves, and product specification sheets.

4. Installation, operation, and maintenance instructions, including factors affecting performance.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.

2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Include diagrams for power, signal, and control wiring.

1.05. INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plan drawings and corresponding product installation 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. Control valve installation location shown in relationship to room, duct, pipe, and equipment.

2. Size and location of wall access panels for control valves installed behind walls.

3. Size and location of ceiling access panels for control valves installed above inaccessible ceilings.

1.06. CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For control valves to include in operation and maintenance manuals.

PART 2 PRODUCTS

2.01. PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.

C. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.

D. Determine control valve sizes and flow coefficients by ISA 75.01.01.

E. Control valve characteristics and rangeability shall comply with ISA 75.11.01.

F. Selection Criteria:

1. Control valves shall be suitable for operation at following conditions:

a. Seal Water: 100 psi and 50 F.

2. Control valve shutoff classifications shall be FCI 70-2, Class IV or better unless otherwise indicated.

3. Valve pattern, straight through, shall be as indicated on Drawings.

4. Modulating straight-through pattern control valves shall have equal percentage flow-throttling characteristics unless otherwise indicated.

5. Fail positions unless otherwise indicated:

a. Seal Water: Open.

6. Selection shall consider viscosity, flashing, and cavitation corrections.

7. Valves shall have stable operation throughout full range of operation, from design to minimum Cv.

8. In water systems, select modulating control valves at terminal equipment for a design Cv based on a pressure drop of 7 psig at design flow unless otherwise indicated.

9. Two-position control valves shall be line size unless otherwise indicated.

10. In water systems, use ball- or globe-style control valves for two-position control for valves NPS 2 and smaller and butterfly style for valves larger than NPS 2.

2.02. CONTROL VALVES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ASCO Valve, Inc.

B. Description:

1. Action: Either normally open or normally closed in the event of electrical power failure as required by the application.

2. Size to close against the system pressure.

3. Manual override capable.

4. Heavy-duty assembly.

5. Body: Brass or stainless steel.

6. Seats and Discs: NBR or PTFE.

7. Solenoid Enclosure: NEMA 250, Type 4.

2.03. ELECTRIC AND ELECTRONIC CONTROL VALVE ACTUATORS

A. Position indicator and graduated scale on each actuator.

B. Type: Motor operated, with or without gears, electric and electronic.

C. Voltage: 120-V ac.

D. Deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.

E. Function properly within a range of 85 to 120 percent of nameplate voltage.

F. Construction:

1. For Actuators Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.

2. For Actuators from 100 to 400 W: Gears ground steel, oil immersed, shaft hardened steel running in bronze, copper alloy or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel or cast-aluminum housing.

3. For Actuators Larger Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.

G. Field Adjustment:

1. Spring Return Actuators: Easily switchable from fail open to fail closed in the field without replacement.

2. Gear Type Actuators: External manual adjustment mechanism to allow manual positioning when the actuator is not powered.

H. Two-Position Actuators: Single direction, spring return or reversing type.

I. Position Feedback:

1. Equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of open and close position.

J. Fail-Safe:

1. Where indicated, provide actuator to fail to an end position.

2. Internal spring return mechanism to drive controlled device to an end position (open or close) on loss of power.

3. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are acceptable only where uniquely indicated.

K. Integral Overload Protection:

1. Provide against overload throughout the entire operating range in both directions.

2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

L. Valve Attachment:

1. Unless otherwise required for valve interface, provide an actuator designed to be directly coupled to valve shaft without the need for connecting linkages.

2. Attach actuator to valve drive shaft in a way that ensures maximum transfer of power and torque without slippage.

3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.

M. Temperature and Humidity:

1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of minus 20 to plus 120 deg F.

2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.

N. Enclosure:

1. Suitable for ambient conditions encountered by application.

2. NEMA 250, Type 2 for indoor and protected applications.

3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.

4. Provide actuator enclosure with heater and control where required by application.

PART 3 EXECUTION

3.01. EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for valves installed in piping to verify actual locations of piping connections before installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

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

3.02. CONTROL VALVE APPLICATIONS

A. Control Valves:

1. Select from valves specified in “Control Valves” Article to achieve performance requirements and characteristics indicated while subjected to full range of system operation encountered.

B. Furnish and install products required to satisfy most stringent requirements indicated.

C. Install products level, plumb, parallel, and perpendicular with building construction.

D. Properly support instruments, tubing, piping, wiring, and conduits to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a force.

E. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

F. Firestop penetrations made in fire-rated assemblies and seal penetrations made in acoustically rated assemblies.

G. Fastening Hardware:

1. Stillson wrenches, pliers, and other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.

2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.

3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

H. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

I. Corrosive Environments:

1. Use products that are suitable for environment to which they will be subjected.

2. If possible, avoid or limit use of materials in corrosive environments, including. but not limited to, the following:

a. Laboratory exhaust airstreams.

b. Process exhaust airstreams.

3. Use Type 316 stainless-steel tubing and fittings when in contact with a corrosive environment.

4. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.

5. Where control devices are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.03. ELECTRIC POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Section 16441 - Enclosed Switches.

C. Furnish and install raceways. Comply with requirements in Section 16130 - Raceways and Boxes.

3.04. CONTROL VALVES

A. Install pipe reducers for valves smaller than line size. Position reducers as close to valve as possible but at distance to avoid interference and impact to performance. Install with manufacturer-recommended clearance.

B. Install flanges or unions to allow drop-in and -out valve installation.

C. Valve Orientation:

1. Where possible, install globe and ball valves installed in horizontal piping with stems upright and not more than 15 degrees off of vertical, not inverted.

2. Install valves in a position to allow full stem movement.

3. Where possible, install butterfly valves that are installed in horizontal piping with stems in horizontal position and with low point of disc opening with direction of flow.

D. Clearance:

1. Locate valves for easy access and provide separate support of valves that cannot be handled by service personnel without hoisting mechanism.

2. Install valves with at least 12 inches of clear space around valve and between valves and adjacent surfaces.

E. Threaded Valves:

1. Note internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.

2. Align threads at point of assembly.

3. Apply thread compound to external pipe threads, except where dry seal threading is specified.

4. Assemble joint, wrench tight. Apply wrench on valve end as pipe is being threaded.

3.05. CONNECTIONS

A. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 16060 - Grounding and Bonding

3.06. IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 16075 – Electrical Identifications.

B. Install engraved phenolic nameplate with valve identification on valve.

3.07. CLEANING

A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.

B. Wash and shine glazing.

C. Polish glossy surfaces to a clean shine.

3.08. CHECKOUT PROCEDURES

A. Control Valve Checkout:

1. Check installed products before continuity tests, leak tests, and calibration.

2. Check valves for proper location and accessibility.

3. Check valves for proper installation for direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.

4. For pneumatic products, verify air supply for each product is properly installed.

5. For pneumatic valves, verify that pressure gauges are provided in each air line to valve actuator and positioner.

6. Verify that control valves are installed correctly for flow direction.

7. Verify that valve body attachment is properly secured and sealed.

8. Verify that valve actuator and linkage attachment are secure.

9. Verify that actuator wiring is complete, enclosed, and connected to correct power source.

10. Verify that valve ball, disc, and plug travel are unobstructed.

11. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.

3.09. ADJUSTMENT, CALIBRATION, AND TESTING

A. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.

B. Stroke control valves with pilot positioners. Adjust valve and positioner following manufacturer's recommended procedure, so valve is 100 percent closed, 50 percent closed, and 100 percent open at proper air pressures.

C. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.

D. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION

SECTION 15120

PIPING SPECIALTIES

PART 1 GENERAL

1.01. SUMMARY

A. Section Includes

1. Backflow preventers.
2. Strainers
3. Hose bibbs.
4. Water-hammer arresters.
5. Trap-seal primer valves.
6. Cleanouts.
7. Roof flashing assemblies.
8. Miscellaneous sanitary drainage piping specialties.

1.02. ACTION SUBMITTALS

A. Product Data: For each type of product.

1.03. INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.04. CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 PRODUCTS

2.01. GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 Annex G.

B. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.

2.02. PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.03. BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Standard: ASSE 1013.

2. Operation: Continuous-pressure applications.

3. Body: Bronze for NPS 2 and smaller.

4. End Connections: Threaded for NPS 2 and smaller.

5. Configuration: Designed for horizontal, straight-through flow.

6. Accessories:

a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.

b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

2.04. 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 with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and 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: 0.033 inch.

6. Drain: Pipe plug.

2.05. HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.

2. Body Material: Bronze.

3. Seat: Bronze, replaceable.

4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.

5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.

6. Pressure Rating: 125 psig.

7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.

8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.

9. Finish for Service Areas: Rough bronze.

10. Finish for Finished Rooms: Chrome or nickel plated.

11. Operation for Equipment Rooms: Wheel handle or operating key.

12. Operation for Service Areas: Wheel handle.

13. Operation for Finished Rooms: Wheel handle.

14. Include operating key with each operating-key hose bibb.

2.06. WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

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. AMTROL, Inc.

b. WATTS.

c. Zurn Industries, LLC.

2. Standard: ASSE 1010 or PDI-WH 201.

3. Type: Copper tube with piston.

4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.07. TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

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. Jay R. Smith Mfg Co; a division of Morris Group International.

b. WATTS.

c. Zurn Industries, LLC.

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.

2.08. CLEANOUTS

A. Cast-Iron Exposed Cleanouts:

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. Jay R. Smith Mfg Co; a division of Morris Group International.

b. Josam Company.

c. WATTS.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.

3. Size: Same as connected drainage piping

4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.

5. Closure: Raised-head, cast-iron plug.

6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

7. Closure: Stainless-steel plug with seal.

2.09. ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

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. Acorn Engineering Company; a Division of Morris Group International.

b. Zurn Industries, LLC.

2. Description: Manufactured assembly made of 6.0-lb/sq. ft., 0.0938-inch- thick, lead flashing collar and skirt extending at least 10 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

a. Open-Top Vent Cap: Without cap.

b. Low-Silhouette Vent Cap: With vandal-proof vent cap.

c. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.10. MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564 rubber gaskets.

2. Size: Same as connected waste piping.

B. 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.

C. Floor-Drain, Trap-Seal Primer Fittings:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.

2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

D. 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.

E. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.

2. Size: As required for close fit to riser or stack piping.

F. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.

2. Size: Same as connected stack vent or vent stack.

G. 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. Size: Same as connected stack vent or vent stack.

H. Expansion Joints:

1. Standard: ASME A112.6.4.

2. Body: Cast iron with bronze sleeve, packing, and gland.

3. End Connections: Matching connected piping.

4. Size: Same as connected soil, waste, or vent piping.

PART 3 EXECUTION

3.01. INSTALLATION

A. 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 unacceptable for this application.

3. Do not install bypass piping around backflow preventers.

B. Install Y-pattern strainers for water on supply side of each control valve.

C. Install water-hammer arresters in water piping according to PDI-WH 201.

D. 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.

E. 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 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.

4. Locate at base of each vertical soil and waste stack.

F. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

G. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

H. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

I. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

J. Install vent caps on each vent pipe passing through roof.

K. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

3.02. CONNECTIONS

A. Comply with requirements for ground equipment in Section 16060 "Grounding and Bonding for Electrical Systems."

B. Fire-retardant-treated-wood blocking is specified in Section 16123 "Building Wire and Cable" for electrical connections.

C. Conduit layout drawings in REVIT to be coordinated with general contractor.

3.03. FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.04. FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required.

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 Section 07530 “, EPDM Membrane Roofing”.

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing

3.05. 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 15130

DOMESTIC WATER PIPING

PART 1 GENERAL

1.01. SUMMARY

A. Section Includes

1. Stainless steel pipe and fittings.

2. Piping joining materials.

3. Transition fittings.

4. Dielectric fittings.

1.02. ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

1.03. INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

PART 2 PRODUCTS

2.01. 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.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G. Plastic piping components shall be marked with "NSF-pw."

C. Comply with NSF Standard 372 for low lead.

2.02. STAINLESS-STEEL PIPE AND FITTINGS

A. Heavy wall stainless steel pipe and fittings shall be Type 316L stainless steel fabricated in accordance with ASTM A312/312M for nominal pipe sizes up to twelve (12) inches.

B. Wall thickness shall be Schedules 40S or 80S pipe in accordance with ANSI B36.19 and as indicated on the piping schedule in the Detailed Specifications.

C. Where flanges are shown, specified or required for connection of stainless steel pipe and fittings to pipe equipment, forged stainless steel slip-on flanges conforming to ANSI 150 pound or 300 pound standards, shall be provided as specified in the Detailed Specifications, welded at the hub and at the face. Flanges, flanged fittings, and flanged joints shall conform to the applicable provisions specified herein for steel flanges, flanged fittings and flanged joints, except that steel bolting shall be cadmium plated to produce a uniform appearance.

D. Fittings:

1. For nominal pipe sizes two (2) inches and smaller shall be of the socket-welding type conforming to the dimensional requirements of ASME B16.11.

2. For nominal pipe sizes 2-1/2” inches and larger shall be butt-welding type conforming to the dimensional requirements of ASME B16.9.

3. Fittings shall conform to the materials and alloy requirements of ASTM A403/A403M

E. All stainless steel pipe and fittings shall be precleaned, pickled, and passivated after fabrication in accordance with the applicable sections of ASTM A380, except where otherwise specified in the Detailed Specifications.

2.04. TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.

2. Pressure rating at least equal to pipes to be joined.

3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

2.05. DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

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. WATTS.

b. Wilkins.

c. Zurn Industries, LLC.

2. Standard: ASSE 1079.

3. Pressure Rating: 125 psig minimum at 180 deg F.

4. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. WATTS.

b. Wilkins.

c. Zurn Industries, LLC.

2. Standard: ASSE 1079.

3. Factory-fabricated, bolted, companion-flange assembly.

4. Pressure Rating: 125 psig minimum at 180 deg F.

5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

PART 3 EXECUTION

3.01. PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. 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 shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance.

C. Install shutoff valve immediately upstream of each dielectric fitting.

D. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

E. Install seismic restraints on piping.

F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

G. 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.

H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

I. Install piping to permit valve servicing.

J. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

K. Install piping free of sags and bends.

L. Install fittings for changes in direction and branch connections.

3.02. 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. 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.

E. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.03. TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

3.04. DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.05. HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger, support products, and installation in Section 15060 “Aboveground Process Piping”.

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.

   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. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.

2. NPS 1-1/2: 108 inches with 3/8-inch rod.

3. NPS 2: 10 feet with 3/8-inch rod.

4. NPS 2-1/2: 11 feet with 1/2-inch rod.

5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.

5. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.

E. Install supports for vertical steel piping every 15 feet.

F. Support piping and tubing not listed in this article according to MSS SP-58 and manufacturer's written instructions.

3.06. CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.

2. 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.

3.07. IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 15076 "Piping and Equipment Identification."

B. Label pressure piping with system operating pressure.

3.08. FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.

b. 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:

1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.

2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.

d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.

b. 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.

c. 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.

d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.

f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.09. 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.

3.10. CLEANING

A. Clean and disinfect potable domestic water piping as follows:

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. Repeat procedures if biological examination shows contamination.

e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11. 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. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Aboveground seal water piping shall be the following:

1. Stainless steel pipe, stainless steel fittings joints.

E. Aboveground domestic water piping shall be the following:

1. Stainless steel pipe, stainless steel fittings joints.

END OF SECTION

SECTION 15140

SUPPORTS AND ANCHORS

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

A. Furnish and install supports and anchors complete with all required accessories to provide complete support systems that can adequately support loads under all operating conditions in accordance with the Contract Documents.

B. The locations of all required supports, anchors, and accessories are not shown on the Drawings.

C. Where supports, anchors, and accessories are shown on the Drawings, they shall be considered to be the minimum allowable requirements. Provide additional supports, anchors, and accessories as required for complete support systems.

D. Equipment, pipe and ductwork support systems shall be designed by a NY State licensed professional engineer.

1.02. SECTION INCLUDES

A. Piping, equipment, and ductwork hangers and supports.

B. Equipment bases and supports.

C. Inserts.

D. Schedules.

1.03. REFERENCES

A. ASME B31.1 - Power Piping, latest edition

B. ASME B31.3 - Process Piping, latest edition

C. ASME B31.9 - Building Services Piping, latest edition

D. ASTM E84 - 13a - Standard Test Method for Surface Burning Characteristics of Building Materials

E. ASTM F708 - Design and Installation of Rigid Pipe Hangers

F. MSS SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacturer

G. MSS SP-69 - Pipe Hangers and Supports - Selection and Application

H. MSS SP-89 - Pipe Hangers and Supports - Fabrication and Installation Practices

I. NFPA 13 - Standard for the Installation of Sprinkler Systems, latest edition

J. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems, latest edition

K. Seismic Considerations - Refer to State Building Codes

1.04. SUBMITTALS

A. Product Data – Provide manufacturers' catalog data including materials and load capacity.

B. Design Data - Indicate load carrying capacity of trapeze, Unistrut, multiple pipe, and riser support hangers.

C. Manufacturer's Installation Instructions - Indicate special procedures and assembly of components.

D. Certification by the Professional Engineer registered in the State of New York stating that the support systems comply with the requirements of specifications and are adequate to support the loads within allowable stress limits under all operating conditions. The type and location of supports, hangers, expansion couplings, and expansion joints shall be selected and supports shown on Drawings shall be supplemented based on pipe stress analysis. Include support layout and design calculations and indicate size and characteristics of components and fabrication details.

E. Design calculations shall be signed and sealed by a Professional Engineer licensed in the State of New York.

F. Seismic Restraints

1. Design calculations signed and sealed by a Professional Engineer licensed in the State of New York.

2. Include dead loads, static seismic loads, capacity of materials, and other information deemed necessary by the designer.

3. Clearly identify design criteria used including, but not be limited to, the following:

a. Peak velocity-rated acceleration coefficient.

b. Seismic hazard exposure group.

c. Seismic performance category.

d. Seismic coefficient.

e. Performance criteria factor.

f. Component amplification factor.

4. Identify all exceptions.

5. If seismic restraints are not required, a Professional Engineer registered in the State of New York shall provide a letter on the Professional Engineer's letterhead with justification. Letter shall contain a signed and sealed Professional Engineer's stamp from the State of New York.

1.05. SUPPORT DESIGN ENGINEER QUALIFICATIONS

A. Engineering Responsibility - Design and preparation of shop drawings and calculations for each support, trapeze, and seismic restraint by a qualified Professional Engineer.

B. Professional Engineer Qualifications - A Professional Engineer who is legally qualified to practice in jurisdiction where the 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 hangers and supports that are similar to those indicated for this project in material, design, and extent.

C. The support system engineer shall have at least five years of experience in the analysis and design of similar systems, including the use of commercial and custom pipe supports and in the use of commercial pipe stress software programs. Provide a detailed resume, including references from projects within the past five years. Acceptance of the proposed support systems engineer shall be subject to the approval of Engineer.

1.06. REGULATORY REQUIREMENTS

A. Conform to National Standard Plumbing Code – Chapter 8 for support of plumbing piping.

B. Supports for Sprinkler Piping - In conformance with NFPA 13.

C. Supports for Standpipes - In conformance with NFPA 14.

PART 2 PRODUCTS

2.01. GENERAL

A. All hangers and supports shall be manufactured or fabricated from materials suitable for the particular area in which they are installed.

1. The Contractor shall install hanger supports that are similar in material construction regardless of piping or conduit application within a given area.

2. Pipe hangers and supports for process pipe, conduit, heating and ventilating piping and ductwork, and plumbing piping shall be constructed of similar materials, (e.g., all hangers and supports located in an interior wet location shall be manufactured from Type 316 stainless steel or polyvinyl chloride (PVC)-coated galvanized steel).

3. Where applicable, fasteners, brackets and supports shall be fabricated in accordance with Section 05500, Miscellaneous Fabrications, and as specified herein.

2.02. SEISMIC RESTRAINTS

A. Provide seismic restraint for all piping, ductwork, equipment, and systems in accordance with all applicable Building Codes.

2.03. MATERIALS

A. Pipe support and hanger material in contact with pipes shall be compatible with the piping material so that neither shall have a deteriorating action on the other.

B. All hangers and supports shall be manufactured or fabricated from materials suitable for the particular area in which they are installed. Reference the Contract Documents for area classifications and the Hanger and Support Application Schedule herein.

C. Where applicable, fasteners, brackets and supports shall be fabricated in accordance with Section 05500, Miscellaneous Fabrications, and as specified herein.

D. Anchors for supports shall be fabricated in accordance with Section 05505, Concrete and Masonry Anchors.

E. Stainless Steel - For the purpose of this section, all stainless steel shall be Type 316.

F. PVC-Coated Materials - PVC-coated hangers and supports shall be installed where applicable for chemical and corrosion-resistant applications as required in the specified areas, or as specifically called out in other sections of these specifications. PVC coating process shall be as follows:

1. Piping systems scheduled as PVC-coated shall have stainless steel support rods, stainless steel mounting hardware, stainless steel fasteners, and stainless steel concrete inserts. All non-stainless steel parts of the hangers and supports shall be PVC coated.

2. Hanger or support shall be hot dipped galvanized including the threads.

3. The zinc surface shall be treated with chromic acid prior to coating to enhance the bond between metal and plastic.

4. All surfaces shall be coated with an epoxy acrylic primer of approximately 0.0005-inch thickness.

5. The coating shall be applied by the liquid plastisol method.

6. The plastisol shall be compounded of pure materials and shall be free of any fillers or secondary plasticizers.

7. A PVC coating shall be bonded to the galvanized outer surface of the product. The bond between the PVC coating and the product surface shall be greater than the tensile strength of the plastic. The thickness of the PVC coating shall be a minimum of 0.040-inch (40 mils).

8. Coating system shall be OCAL-40 as provided by Occidental Coating Company, Van Nuys, CA; Plasti-Bond Red as provided by Robroy Industries, Verona, PA; or equal.

G. Steel and steel alloy hangers and supports shall conform to ASME B31.1, ASME B31.3, ANSI B31.10, and MSS Standard Practice SP-58.

H. Fiberglass Reinforced Plastic (FRP) Hangers and Supports

1. FRP Systems - Use StrutTech, Aickinstrut, or equal.

2. All vinylester (Series VF) and polyester fiberglass (Series PF) shall be Class 1 ASTM E84, and Polyurethane V-O shall be UL94V PVC (Capping strip) 5V and V-O UL94.

3. All fiberglass channels shall be vinylester or polyester resin.

4. All pipe clamps shall be manufactured of thermoplastic polyurethane, polyester or thermoset vinylester fiberglass, compatible with pipe size to be supported.

5. All fasteners including channel nuts, bolts, nuts, washers, couplers shall be glass filled polyurethane resin.

6. All thread rods shall be vinylester fiberglass.

7. Verify that the materials of the FRP support system meet the required chemical resistance for the chemical being transported.

2.04. MANUFACTURERS

A. Anvil International

B. Carpenter & Patterson

C. Unistrut Corporation

D. Cooper Industries - B-Line Systems

E. Globe Division of United States Gypsum

F. Robroy Industries

G. OCAL

H. Standon

I. Or approved equal

2.05. HANGER AND SUPPORT SCHEDULES

A. The following schedules are provided to identify the type of hangers and supports acceptable under this Contract. Provide the type of hangers and supports in these schedules, however, the acceptable materials of construction shall be provided as identified in the “Application Schedule” for the various systems and the intended location of the hanger or support. Some pipe supports are not specifically labeled on the Drawings for clarity.

PIPE HANGER AND SUPPORT SCHEDULE – INSIDE PROCESS PIPING

A	All Materials, Non-Insulated	Clevis hanger
A	All Materials, Insulated	Clevis hanger with protection shields
B	Ductile Iron, Steel	Pipe stanchion saddle, pipe support and floor plate with stainless steel yoke.
B-C	Ductile Iron, Steel	Pipe stanchion saddle, pipe support and floor plate with stainless steel yoke and clamp
B-F	Ductile Iron, Steel	Pipe stanchion saddle, pipe support and floor plate with stainless steel flange mounting yoke
C	Ductile Iron, PVC	Split pipe clamp with base flange
D	PVC and Steel	PVC-coated clamp
E	Ductile Iron, Steel	Pipe support in trench
F	Ductile Iron, Steel	Concrete base fitting support

G	Ductile Iron, Steel	Concrete pipe support
H	Ductile Iron, Steel	Welded steel bracket
H-V	Ductile Iron, Steel	Dual welded steel brackets with friction pipe clamp
I	PVC, Hose	Pipe channel support
J	Ductile Iron, Steel PVC	Channel framing
K	Ductile Iron, Steel	Steel pipe floor support
L	Ductile Iron, Steel, PVC	Concrete pipe support in trench
M	Ductile Iron, Steel, PVC	Steel angle pipe support
R	Ductile Iron, Steel, PVC, HDPE	Riser clamp at concrete deck

B. Components of the alphabetical pipe support “Types” are further defined below. The numerical “Type” listed is based on nomenclature from MSS SP-58. Support materials from the manufacturers shall correspond to the MSS SP-58 type.

C. Refer to the support details on the Drawings for further requirements.

D. Process Piping

1. U-Bolts - Type 24.

2. Clevis Hangers - Type 1. Use Type 39 or 40 protection shields for insulated pipe.

3. Yoke Type Pipe Clamp - Type 2. Use for pipe with up to 4 inch insulation.

4. Pipe Clamps - Type 3, 4 and 12. Do not use for insulated pipe.

5. Riser Clamps - Type 8 and 42. Do not use for insulated pipe.

6. Straps - Type 26.

7. Pipe Rollers and Roller Supports - Type 41 and 43. Use Type 39 or 40 protection shields for insulated pipe.

8. Trapezes - Type 59. Use Type 39 or 40 protective shields for insulated pipe. To be used only if all of the pipes to be supported are at the same bottom elevation.

9. Roller Hanger - Type 44, Use Type 39 or 40 protective shields for insulated pipe.

10. Stanchions

    a. Pipe Saddle - Type 37. Use Type 39 or 40 protective shields for insulated pipe.

    b. Adjustable Pipe Saddle with U-bolt, Type 38. Use Type 39 or 40 protective shields for insulated pipe.

11. Wall Brackets

    a. For 4-inch diameter and larger piping, use only where indicated on Drawings.

    b. Light duty, Type 31.

c. Medium duty, Type 32.

d. Heavy duty, Type 33.

12. Structural Attachments

a. Welded Beam Attachment - Type 22.

b. Plate Lug - Type 57.

c. Concrete Inserts and Attachments - Anvil Figure 47, 49, and 52, or equal.

13. Strut Support Systems - Use Unistrut Corporation, B-Line Systems, Globe Division of United States Gypsum, or equal.

a. System shall permit rigid metal construction without welding or drilling.

b. All members shall be fully adjustable, demountable and reusable.

c. One manufacturer shall furnish system complete with all nuts, bolts, couplers, channels and all other required fittings and mechanical accessories.

d. Channels and accessories shall be galvanized steel with 20 mil PVC coating, all of the same color.

e. All mounting hardware, fasteners and concrete inserts shall be Type 316 stainless steel.

f. Pipe clamps shall be PVC-coated galvanized straps with stainless steel rods, nuts, and flat washers.

g. Verify that the load carrying capacity of the strut system is adequate for weight of pipes and contents and span utilized.

E. Hanger rods shall be machine threaded and based on root diameter. When hanger rods are over 18 inches in length, lateral bracing shall be provided every fourth hanger. The minimum rod diameter shall be as follows:

Pipe Diameter (Inches)	Minimum Rod Size (Inches)
2 and smaller	3/8
2-1/2 to 3-1/2	1/2
4 and 5	5/8
6 and 8	3/4
10 and 12	7/8
14 to 18	1
20 and 24	1-1/4

PART 3 EXECUTION

3.01. GENERAL

A. All piping to be supported from floors, concrete slabs, ceilings or walls shall have supports and parts required for the installation of the piping systems which conform to the applicable requirements of ASME B31.1 and ASME B31.3 to the requirements of Chapter 1, Section 6 of the ANSI Code for Pressure Piping (B31.1), except as modified and supplemented by the requirements set forth in these Specifications.

B. All piping shall be rigidly supported from the building structure by approved hangers, inserts, or supports, with adequate provisions for expansion and contraction. No piping shall be supported from other piping or from metal stairs, ladders, and walkways unless specifically directed by Engineer.

C. In addition to the hangers and supports spaced as specified above, Contractor shall furnish and install additional hangers and supports at all valves, fittings, and pipe line equipment. Holding devices for valves and other pipe line appurtenances shall be designed and constructed to hold each unit securely.

D. All vertical pipes shall be supported at each floor and/or at intervals of not more than 10 feet by approved pipe collars, clamps, brackets, or wall rests, and at all points necessary to ensure rigid construction.

E. Spacing of supports for PVC pipe and provision for expansion shall be determined by operating temperature, size of pipe, and other conditions. It shall be such as to prevent subsequent visible sagging of the pipe between supports due to plastic deformation.

F. In general, adjustable saddle supports shall be used when the height of the centerline of the pipe is 0 to 6 feet above the floor and hangers or brackets shall be used when the height of the centerline of pipe is greater than 6 feet.

G. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, 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.

H. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Non-adhesive-type anchors are only allowed in applications in which the support is suspended from the ceiling and shall comply with Section 05505, Concrete and Masonry Anchors. All other applications shall be provided with adhesive anchors.

I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Load Distribution - Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. The hangers and supports shall be designed to resist or to allow controlled movement caused by operation of equipment.

L. Pipe Slopes - Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.

3.02. SUPPORT INTERVALS

A. At a minimum, additional supports or anchors will be required at:

1. All bends on pump discharge line to prevent vertical or horizontal movement resulting from pressure thrusts.

2. Each side of all couplings in the horizontal plane to eliminate vertical force on couplings.

3. All branch connections to eliminate vertical and horizontal movement.

4. Both side of expansion joints to prevent horizontal movement.

5. All pipe joints subject to torque along centerline of pipe. Piping shall be supported so that pumps and other equipment may be removed without providing additional pipe support.

6. Where depicted on the Drawings, pipe supports shall be of the type indicated.

B. Flanged Ductile Iron Pipe - Supports and hangers for pipe 1-1/4 inches and larger, support spacing shall be 10 feet maximum.

1. Additional supports and hangers will be required for grooved end ductile iron pipe and fittings at the Contractor’s expense.

C. Plastic Pipe - Supports and hangers and/or braces for plastic piping shall be used at all bends and support spacing shall be 4 feet maximum horizontally and vertically, except non-metallic electrical conduit support spacing shall be 3 feet maximum.

1. Supports and hangers for plastic piping shall include saddles and bands to distribute load and thus avoid localized deformation of the pipe.

2. All necessary inserts or appurtenances shall be furnished and installed in the concrete or structures for adequately securing these supports to the structure.

D. Steel and Wrought Iron Pipe - Supports and hangers for steel and wrought iron pipe less than 1-1/4 inches, support spacing shall be 8 feet maximum; 1-1/4 inches and larger, support spacing shall be 10 feet maximum.

E. Copper Pipe - Copper pipe 1/2-inch to 1-inch, support spacing shall be 6 feet maximum; 1-1/4-inch and over, support spacing shall be 10 feet maximum.

F. Cast Iron Pipe - Cast iron soil pipe shall be supported at each length, close to bell.

3.03. INSERTS

A. Provide inserts for suspending hangers from concrete slabs and sides of concrete beams.

3.04. HANGER AND SUPPORT APPLICATION SCHEDULE

A. The materials of construction for all hangers and supports, applicable to inside process piping, fire protection, plumbing and HVAC systems, used on the project, shall be in accordance with the Hanger and Support Application Schedule. Refer to the Drawings for the classification for each room.

Area	Acceptable Materials
EXTERIOR: • Exposed to outdoor conditions • Inside tanks • Submerged locations unless otherwise specified	Type 316 Stainless Steel
INTERIOR: Corrosive or Wet/Corrosive Areas (either Unclassified or Hazardous) • Interior sodium hypochlorite storage and feed areas	FRP
Unclassified, Unclassified/Wet Areas • Pump rooms, mechanical rooms, motor rooms • Piping galleries, dry pits • Below-grade vaults, manholes, and handholes • Polymer storage and feed areas	Type 316 Stainless Steel
Hazardous, Hazardous/Wet Areas • NEC Class I, Division 1 or 2, Groups C and D	Type 316 Stainless Steel

END OF SECTION

SECTION 15150

SANITARY WASTE AND VENT PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.

2. Specialty pipe fittings.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.03 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.

B. Field quality-control reports.

PART 2 PRODUCTS

2.01 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.

B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.02 PIPING MATERIALS

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. 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.

2.03 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class.

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.04 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

2. Unshielded, Non-pressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Dallas Specialty & Mfg. Co.

2) Fernco Inc.

b. Standard: ASTM C 1173.

c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

d. End Connections: Same size as and compatible with pipes to be joined.

e. Sleeve Materials:

1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.

2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.

3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

3. Shielded, Non-pressure Transition Couplings:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1) Cascade Waterworks Mfg. Co.

2) Mission Rubber Company, LLC; a division of MCP Industries.

b. Standard: ASTM C 1460.

c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

d. End Connections: Same size as and compatible with pipes to be joined.

PART 3 EXECUTION

3.01 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.

1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.

2. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. 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.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices.

K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.

1. 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.

2. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.

a. Straight tees, elbows, and crosses may be used on vent lines.

3. Do not change direction of flow more than 90 degrees.

4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.

a. Reducing size of waste piping in direction of flow is prohibited.

L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Waste: 2 percent downward in direction of flow for piping NPS 3 and smaller; 2 percent downward in direction of flow for piping NPS 4 and larger.

2. Horizontal Sanitary Waste Piping: 2 percent downward in direction of flow.

3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

M. 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."

N. Plumbing Specialties:

1. Install backwater valves in sanitary waster gravity-flow piping.

a. Comply with requirements for backwater valves specified in Section 15120 " Piping Specialties."

2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.

a. Comply with requirements for cleanouts specified in Section 15120 "Piping Specialties."

3. Install drains in sanitary waste gravity-flow piping.

a. Comply with requirements for drains specified in Section 15120 "Piping Specialties."

O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.02 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Grooved Joints: Cut groove ends of pipe according to AWWA C606. 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.

3.03 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.

2. In Waste Drainage Piping: Shielded, non-pressure transition couplings.

3.04 VALVE INSTALLATION

A. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.

2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.

3. Install backwater valves in accessible locations.

4. Comply with requirements for backwater valve specified in Section 15120 "Piping Specialties."

3.05 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices.

B. Comply with requirements for pipe hanger and support devices and installation specified in Section 15060 "Aboveground Process Piping".

1. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.

2. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.

3. Vertical Piping: MSS Type 8 or Type 42, clamps.

4. Install 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.

c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

6. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.

2. NPS 3: 60 inches with 1/2-inch rod.

3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.

4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.

5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.

6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 84 inches with 3/8-inch rod.

2. NPS 1-1/2: 108 inches with 3/8-inch rod.

3. NPS 2: 10 feet with 3/8-inch rod.

4. NPS 2-1/2: 11 feet with 1/2-inch rod.

5. NPS 3: 12 feet with 1/2-inch rod.

6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.

I. Install supports for vertical steel piping every 15 feet.

J. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2: 84 inches with 3/8-inch rod.

2. NPS 3: 96 inches with 1/2-inch rod.

3. NPS 4: 108 inches with 1/2-inch rod.

K. Install supports for vertical stainless-steel piping every 10 feet.

L. Support piping and tubing not listed above according to MSS SP-58 and manufacturer's written instructions.

3.06 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect waste and vent piping to the following:

1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.

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 waste and vent piping in sizes indicated, but not smaller than required by plumbing code.

4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.

5. Install horizontal backwater valves with cleanout cover flush with floor.

6. Comply with requirements for backwater valves cleanouts and drains specified in Section 15120 "Piping Specialties."

7. Equipment: Connect waste piping as indicated.

a. Provide shutoff valve if indicated and union for each connection.

b. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.07 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping.

B. Comply with requirements for identification specified in Section 15076 "Piping and Equipment Identification."

3.08 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.

2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary waste 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.

a. 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 waste and vent piping until it has been tested and approved.

a. Expose work that was covered or concealed before it was tested.

3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.

   a. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.

   b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.

   c. Inspect joints for leaks.

4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.

   a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.

   b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.

   c. Air pressure must remain constant without introducing additional air throughout period of inspection.

   d. Inspect plumbing fixture connections for gas and water leaks.

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 required corrective action.

3.09 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect sanitary waste and vent piping 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.

D. Repair damage to adjacent materials caused by waste and vent piping installation.

3.10 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:

   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

C. Aboveground, vent piping NPS 4 and smaller shall be the following:

   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

END OF SECTION

SECTION 15170
MOTORS

PART 1 GENERAL

1.01. SECTION INCLUDES

A. All electric motors supplied under these Contract Documents shall conform tothis specification as minimum requirements.

B. All electric motors shall conform to ANSI Standards for Rotating Electrical Machinery (Designation C50) and to NEMA Standards MG-1 for Motors and Generators (NEMA Standard Publication latest revision) and to NEC, Article 430.

C. The rating of the motors offered shall in no case be less than the horsepower required in the Contract Documents.

D. Motors shall operate without an undue noise or vibration and shall show no signs of electrical unbalance.

E. Motor efficiency shall be a prime consideration in selection of all motors. Unless otherwise specified in the individual equipment specifications, motors shall meet the requirements of Article 1.08.

F. Owner shall receive all rebates from the utilityas applicable. Contractor shall provide paid invoices for all motors for which rebates are available. Add specific rebate information.)

1.02. SUBMITTALS

A. Shop Drawings of Electric Motors - Submit in accordance with Sections 01300, Submittals, and 01640, Equipment-General.

B. Include with submittals:

1. Electric characteristics.

2. Design characteristics.

3. Mechanical construction.

4. Manufacturer’s name.

5. Manufacturer’s type.

6. Pertinent specifications for the use intended.

7. Name of the equipment to be driven.

8. Motor storage requirements.

C. Tabulate the following information in one location on each electric motor shop drawing submittal:

1. Motor manufacturer.
2. Model.
3. Frame number.
4. Type of enclosure.
5. Volts.
6. Hertz.
7. Phase.
8. NEMA design.
9. Code letter.
10. Locked rotor amps.
11. Locked rotor torque.
12. Nameplate horsepower.
13. Motor rpm, full load nameplate.
14. Insulation class.
15. Service factor.
16. Maximum ambient temperature.
17. Maximum temperature rise.
18. Shop painting.
19. Nominal efficiency.
20. Guaranteed minimum efficiency at 50, 75 and 100 percent full load.
21. Minimum power factor at 50, 75 and 100 percent load.
22. Resistance temperature device information (if applicable).

1.03. INSULATION

A. Minimum NEMA Class B insulation unless otherwise noted in the individual equipment specifications.

B. Provide Class F insulation if required by the manufacturer to meet specified energy efficiency.

C. Use Class F or H insulation where ambient temperatures exceed 104 degrees F (40 degrees C) as shown on the Contract Drawings or elsewhere in the specifications.

D. Where motors are to be used with variable frequency drives (VFDs), insulation systems shall be “inverter grade” with Class F thermostats. Insulation system shall meet NEMA MG-1, Part 31 standards.

1.04. RATINGS AND DESIGN

A. Furnish with adequate ratings to accelerate and drive connected equipment under all normal operating conditions without exceeding nameplate ratings.

B. Furnish with service factors in accordance with NEMA standards as follows unless otherwise noted in individual equipment specifications.

Type of Machine	Minimum Service Factor (SF)
Mill and Chemical Duty	1.15
Open Drip-Proof	1.15
Submersible	1.15
Inverter Duty	1.0
All Others	1.0

C. Motors shall operate successfully under running conditions at rated load and frequency with a voltage variation up to 10 percent; at rated load and voltage with a frequency variation up to 5 percent; and at rated load with a combined variation in voltage and frequency not more than 10 percent above or below the rated voltage and frequency provided that the frequency variation does not exceed 5 percent.

D. Assume voltage unbalance to be 1 percent. Altitude is less than 3,300 feet.

E. Assume ambient temperatures to be 40 degrees C for motors in air and 25 degrees C for submersible motors.

F. Motor winding temperature rise shall be as follows:

	Class of Insulation		
	B	F	H
Open, Drip-Proof Motors	80°C	105°C	125°C
Totally Enclosed Fan-Cooled Motors	80°C	105°C	125°C
Totally Enclosed Non-Ventilated Motors	85°C	ll0°C	135°C
Explosionproof motors	80°C	105°C	125°C
All Other Motors with 1.15 SF or Higher	90°C	ll5°C	--

G. Use the applicable paragraphs of NEMA MG1 12.42 in making design selections.

H. Unless otherwise specified, all three phase motors shall be constant speed, squirrel cage induction type.

1. The Contractor shall provide multi speed (multiple windings or consequent poles - single winding, wound rotor, etc.) where required as specified in individual equipment specifications.

I. Motor Voltages

1. Motors of 1/2 HP and Larger - Squirrel cage induction type designed for 3 phase, 60 cycle, 230/460 volt operation unless otherwise specified.

2. Motors Smaller Than 1/2 HP - Capacitor type designed for single phase, 60 cycle, 120 volt operation unless otherwise specified.

3. Motors indicated on the Contract Drawings and/or specified in the specifications as 208 volt shall be specially wound for voltage indicated and/or specified.

4. Dual-rated motors (i.e., 208/230 volts) are not acceptable for operation on 208 volts.

J. Motors intended for inverter duty (those controlled through variable speed drives), shall be specifically manufactured for inverter duty and shall be rated to meet or exceed the requirements in MG-1, Part 31. Motor rated “suitable for use with VFDs” or similar wording are acceptable.

K. Hazardous area motors shall be certified to meet UL requirements for operation over the motors entire speed range.

L. Unless otherwise specified, all single-phase motors shall be NEMA design letter M or N, designed to withstand full voltage starting in accordance with MG12.32.

1. Motors shall comply with NEMA Standards for Definite Purpose Motors (paragraphs 18.001 18.717).

M. In general, capacitor start induction run or split phase-type motors shall be used unless otherwise approved by the Engineer.

N. Shaded pole motors larger than 1/8 HP will not be allowed.

O. Thermal overload protectors and any auxiliary components necessary to provide required starting characteristics including capacitors, resistors and automatic switching devices shall be furnished and mounted integrally unless motor starters with overload protection are provided.

1.05. MECHANICAL CONSTRUCTION

A. Unless otherwise specified, electric motors shall be of the following types of construction according to the degree of mechanical protection:

1. Totally Enclosed, Explosionproof Motors - When located in areas designated as hazardous locations (explosionproof) (NEC locations Class I, Divisions 1 or 2).

a. See the Contract Drawings for other hazardous area classifications.

2. Totally Enclosed, Fan Cooled (TEFC) Motors - When located outdoors or indoors in wet areas such as washdown areas or elsewhere if specified.

    a. Winding (condensation) heaters shall be provided for all motors 7-1/2 HP and larger when specified.

3. Mill and Chemical Duty or Severe Duty - Suitable for use in corrosive areas unless otherwise specified in individual equipment specifications.

4. Submersible Motors - For submerged application.

    a. Provide motor winding thermal protection in motors 1 HP and larger.

5. In all other cases, they shall be open drip-proof.

B. Encapsulated Windings - Where specified, an additional “dip and bake” will not be acceptable. Encapsulation shall be Contour Mold Everseal by U.S. Motors; Costum Polyseal by General Electric; or equal.

C. Bearings

1. Unless otherwise specified or required, motors rated above 2 HP shall have the bearings of the grease lubricated, anti-friction ball type with conveniently located grease fittings.

2. Provide a means of preventing bearings from becoming overgreased (such as double shields on bearings or pressure sensitive relief fittings).

3. Unless otherwise specified, bearings shall be rated at a minimum B-10 life of 150,000 hours for direct-coupled motors or 50,000 hours for belted motors.

4. Submersible motors shall have bearings rated of an L-10 or B-10 life of minimum of 17,500 hours.

D. Vertical shaft construction, the motors shall have adequate thrust bearings to carry all motor loads and any other operating equipment loads.

1. Grease slingers to be provided for non-submersible motors.

2. For motors used with VFDs, provide conductive micro-fiber shaft ground rungs (SGRs) by AEGIS on the drive end of the motor and grounded through the motor frame. Provide insulated bearing on non-drive end. Spring-loaded contact brushes are not acceptable.

E. Horizontal Shaft Construction - Coupled to fluid pumps, the motors shall either have adequate thrust bearings or they shall have the couplings end play and rotor float coordinated to prevent damage to rotor bearings.

1. For motors used with VFDs, provide conductive micro-fiber SGRs by AEGIS on the drive end of the motor and grounded through the motor frame. Provide insulated bearing on non-drive end. Spring-loaded contact brushes are not acceptable.

F. Rotors

1. Statically and dynamically balanced.

2. Have secondary bars of heavy copper silver brazed to one piece end rings or they shall have rotor windings of one piece cast aluminum.

3. Where applicable, construct with integral fans.

G. Inverter duty motors shall have enhanced rotor and stator designs.

H. Non reversing ratchets shall be provided where specified in the individual equipment specifications.

I. Nameplates - Stainless steel furnished with all motors, with markings in accordance with NEMA MG1, latest revision, MG1 10.38.

J. Terminal Boxes

1. Sized in accordance with NEC, Article 430-12 and of sufficient size to accommodate conduits and conductor sizes as shown on Contract Drawings.

2. Furnish rubber gasketed terminal boxes with splash proof and totally enclosed motors.

3. Horizontal Motors - Locate on the left hand side, when viewing the motor from the drive shaft ends and design such that conduit entrance can be made from above, below, or either side of the terminal box.

4. Include grounding lug in terminal box.

5. Oversize terminal boxes in the following applications:

a. Motors 7-1/2 HP and larger operating at 208 or 230 volts.

b. Motors 20 HP and larger operating at 460 volts.

K. Motors used with belt drives shall have grease slingers on the sheave end and sliding bases to provide for belt take-up.

L. Cast iron construction for all motors, when available for the application.

1.06. MOTOR POWER FACTORS

A. Provide when called for on the Contract Drawings.

B. Provide for all three phase motors, 7 1/2 HP or larger, 1200, 1800, and 3600 rpm (nominal), 60 Hertz, constant single speed (not VFD controlled), squirrel cage induction type, which do not have a minimum power factor of 85 percent. Motors which cannot meet this criteria shall have power factor correction capacitors, switched integrally with the motors (unless otherwise required by either the motor or starter manufacturer), which will bring the power factor up to a minimum of 90 percent.

C. Furnish and install, at no additional cost to the Owner, the capacitors and provide all necessary wiring to connect them to the motor terminals or motor controller terminals.

1. Properly size fused switch or circuit breaker to serve as a disconnect for the capacitor.

D. Capacitor and Disconnect Enclosure

1. Indoors Mounting (Non-Hazardous) - NEMA 12 wall mounted.

2. Indoor Wet Areas - NEMA 4 wall mounted.

3. Outdoors Mounting - NEMA 4 wall, pad, or mounting stand mounted.

4. Explosionproof Areas - NEMA 7 wall mounted (DS only)*.

5. Corrosive Areas - NEMA 4X wall mounted*.

*Locate capacitor outside the hazardous or corrosive area.

E. Size capacitors so they do not increase the self-excitation voltage above the motor nameplate rating.

F. Do not use capacitors on motors controlled by VFDs.

G. When used with solid-state starters, energize only after bypass or full speed bypass contactor is energized. Verify with starter manufacturer their connection requirements and follow them.

1.07. MOTOR EFFICIENCY

A. All single speed, three phase, squirrel cage induction-type motors 1 HP or larger, 60 Hertz, shall have nominal efficiencies in accordance with Table 15170-1, unless specifically otherwise specified in the respective equipment section.

1. Determine efficiencies by using IEEE Test Procedure 112, Test Method B using segregated losses. Motors shall be listed by their manufacturers and be nameplated with words such as “High Efficiency,” “Premium Efficient,” and “Energy Saver.”

2. List guaranteed minimum efficiencies on motor nameplate. Adhere to the latest nominal efficiencies eligible for a rebate published by the local utility where rebates are available. Those efficiencies may be higher than those listed in Table 15170-1.

3. Where rebates are available, submit to the Owner paid invoices for each specific motor supplied for which a rebate is being sought.

4. If a motor submitted does not meet the minimum efficiency, the Contractor shall be required to credit the Owner with the utilities rebate plus the cost of operating the motor for 20 years for the duty hours applicable to the motor, but no less than 2,190 hours per year, at the reduced efficiency with an estimated utility cost increase of 50 percent every 5 years.

1.08. FIELD TESTING

A. All three phase electric motors 1/2 HP and larger and all single phase electric motors 1 HP and larger shall be field tested by the Contractor at as near operating conditions as possible. Complete and submit all of the information required by the attached "Motor Test Record" for all motors to be tested per the above. Submit record prior to the issuance of the "Substantial Completion Certificate." See Section 01700. Contractor, for the purposes of this item, is the one furnishing and/or installing the final motor-driven unit.

B. All testing shall be witnessed by the Engineer.

C. Submit completed forms in quadruplicate (one set to be submitted at the time when substantial completion is requested, and one set to be placed in each of the submitted O&M manuals).

1.10. MOTOR SHOP TESTS

A. Perform motor shop tests in accordance with the IEEE Code for polyphase induction machines. Use NEMA report of test forms and submit results to the Engineer, in five copies, for his approval.

B. Test each motor and submit report for power factor and efficiency at 50, 75, and 100 percent of its rated horsepower; for insulation resistance and dielectric strength; for heating; and for compliance with all specific performance requirements.

C. For motors less than 50 HP, provide guaranteed performance data based on previous testing of the motor design. For motors of 50 HP or larger, make complete tests of each motor and furnish certified test data sheets.

1.11. VERTICAL HOLLOW SHAFT MOTORS

A. Where specified, design vertical hollow shaft motors to carry the motors, pumps, and associated equipment’s full thrust. Equip motors with oil lubricated spherical roller thrust bearings and lower grease lubricated radial guide bearings. Provide motors with visual oil level indicators and sufficient oil to fill the motor.

B. Vertical Adjustment - By means of a lockable nut at the top of the shaft.

C. Non-Reversing Ratchets - Provide where specified in the individual equipment specifications and where suitable for continuous operation at any speed between 50 and 100 percent of rated speed.

1.12. TWO-SPEED MOTORS

A. Motors 1/2 HP and Larger Specified as Two Speed Motors - Two windings unless otherwise noted. Motors less than 1/2 HP will be permitted with single windings. Speeds of the motors shall be as specified. Two speed motors shall be tested at the higher speed.

1.13. PAINTING

A. All motors shall have a manufacturer's standard shop rust-resisting priming coat. Finish coat, either shop or field applied, shall be in accordance with Section 09900, Painting.

1.14. HAZARDOUS OR EXPLOSIONPROOF AREAS

A. All areas noted as hazardous or explosionproof (as defined in the latest edition of the National Electrical Code) shall have all work done in accordance with the requirements of the National Electrical Code (NEC) for that particular "class" and "division" and all equipment enclosures (for motors, starters, switches, capacitors, etc.), fittings, conduits and appurtenances shall be of a type approved for the area.

B. Unless otherwise shown, all hazardous or explosionproof areas shall be Class I, Division 1 (Groups C and D); locations and all equipment enclosures, fittings, conduits and appurtenances shall be NEMA Type 7 and approved for use in Class I, Division 1, Groups C and D atmospheres.

C. All wiring in these areas shall be done in accordance with the applicable NEC provisions.

1.15. STORAGE

A. Motors shall only be stored in clean, dry, indoor, climate-controlled spaces (heated, dehumidified, and air conditioned). No outdoor storage will be allowed.

B. Motors with space heaters (condensation heaters) shall have the heaters continuously energized while the motor is either in storage or in place but not operational.

C. Motors in storage awaiting installation shall be rotated periodically as recommended by the manufacturer as published in literature included in the initial shop drawing submittal. In the absence of published manufacturer’s literature, the Owner/Engineer shall provide storage requirements.

(continued)

TABLE 15170-1

NOMINAL FULL LOAD EFFICIENCIES FOR NEMA DESIGN A AND B
"NEMA PREMIUM™" INDUCTION MOTORS RATED 600 VOLTS OR LESS (RANDOM WOUND)

	OPEN DRIP-PROOF*				TOTALLY ENCLOSED FAN-COOLED*			
HP	900	1200	1800	3600	900	1200	1800	3600
1	75.5	82.5	85.5	77.0	75.5	82.5	85.5	77.0
1.5	77.0	86.5	86.5	84.0	78.5	87.5	86.5	84.0
2	86.5	87.5	86.5	85.5	84.0	88.5	86.5	85.5
3	87.5	88.5	89.5	85.5	85.5	89.5	89.5	86.5
5	88.5	89.5	89.5	86.5	86.5	89.5	89.5	88.5
7.5	89.5	90.2	91.0	88.5	86.5	91.0	91.7	89.5
10	90.2	91.7	91.7	89.5	89.5	91.0	91.7	90.2
15	90.2	91.7	93.0	90.2	89.5	91.7	92.4	91.0
20	91.0	92.4	93.0	91.0	90.2	91.7	93.0	91.0
25	91.0	93.0	93.6	91.7	90.2	93.0	93.6	91.7
30	91.7	93.6	94.1	91.7	91.7	93.0	93.6	91.7
40	91.7	94.1	94.1	92.4	91.7	94.1	94.1	92.4
50	92.4	94.1	94.5	93.0	92.4	94.1	94.5	93.0
60	93.0	94.5	95.0	93.6	92.4	94.5	95.0	93.6
75	94.1	94.5	95.0	93.6	93.6	94.5	95.4	93.6
100	94.1	95.0	95.4	93.6	93.6	95.0	95.4	94.1
125	94.1	95.0	95.4	94.1	94.1	95.0	95.4	95.0
150	94.1	95.4	95.8	94.1	94.1	95.8	95.8	95.0
200	94.1	95.4	95.8	95.0	94.5	95.8	96.2	95.4
250	95.0	95.8	95.8	95.0	95.0	95.8	96.2	95.8
300	--	95.8	95.8	95.4	--	95.8	96.2	95.8
350	--	95.8	95.8	95.4	--	95.8	96.2	95.8
400	--	--	95.8	95.8	--	--	96.2	95.8
450	--	--	96.2	96.2	--	--	92.2	95.8
500	--	--	96.2	96.2	--	--	96.2	95.8

*Nominal speed; for two-speed motors, the efficiency applies to the highest speed.

The above nominal full load efficiencies became effective June 1, 2016 per CFR 431.25 Energy Conservation Standards and Effective Dates.

For fire pump motors, submersible motors, other motor horsepowers, speeds, and for Design C and D motors, the efficiencies shall be in accordance with the applicable equipment specification sections.

MOTOR TEST REPORT

Equipment Description_____ Equipment No._____
Equipment Loc._____
Drawing Nos. and Rev._____
MCC/Panel No._____ Section/CKT. No._____
Control CKT. No._____

NAMEPLATE DATA

Motor Mfr._____ HP_____ Rpm_____ S.F_____
Volts_____ Phase_____ F.L. Amp_____ KVA Code_____ O° Rise _____
Serial No._____ Other_____
Locked Rotor KVA_____ Efficiency_____

Prestart Checks	Date
Lubrication Checked (Motor and Driven Equipment)	_____
Motor Rotates Freely	_____
Overload Heater Size/Setting_____ (located at starter)	_____
Control Circuit Tested	_____
Breaker Size (Frame Size/Trip Element Rating)_____	_____

Motor Insulation Resistance (Megger)
Test Volts _____ (500V for up to 250V motors and 1000V for up to 600V motors)
Test Duration - 1 minute

Phase A to Gnd_____ Phase B to Gnd_____ Phase C to Gnd_____
Phase A to B_____ Phase B to C_____ Phase C to A_____

UNCOUPLED DATA

(Provide this only when motor is shipped, uncoupled. Do not uncouple motor from drive to test.)

Bus Voltage_____ Inrush Current_____ Amps_____ Sec Run in Time_____
Average Running Current_____ A_____ B_____ C Rotation *_____
Rpm_____
Performed by_____ Date_____
Approved by_____ Date_____
Test Engineer

COUPLED DATA

Bus Voltage_____ Inrush Current_____ Amps_____ Sec Run in Time_____
Average Running Current_____ A_____ B_____ C Rotation *_____
Rpm_____ System Lineup/Conditions_____
Test Equipment Control Nos._____
Remarks_____
Performed by_____ Date_____
Approved by_____ Date_____
Test Engineer

*As viewed from motor outboard end. EQUIPMENT NO._____

END OF SECTION

SECTION 15260

HVAC PIPING INSULATION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Refrigerant suction and hot-gas piping insulation.

B. Related Requirements:

1. Section 15530 – Refrigerant Piping

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Flexible Elastomeric Insulation and Adhesive

1. Aeroflex USA, Sweetwater, TN or Approved Equal
2. Armacell LLC, Chapel Hill, NC or Approved Equal
3. K-Flex USA, Youngsville, NC or Approved Equal
4. Or approved equal

B. Vaper-Barrier Mastic

1. Foster Brand; H. B. Fuller Construction Products, St. Paul, MN or Approved Equal
2. Knauf Insulation, Shelbyville, TN or Approved Equal
3. Or approved equal

C. Sealants

1. Foster Brand; H. B. Fuller Construction Products, St. Paul, MN or Approved Equal
2. Or approved equal

D. Field Applied Jackets

1. Foster Brand; H. B. Fuller Construction Products, St. Paul, MN or Approved Equal
2. Or approved equal

E. Tapes

1. Foster Brand; H. B. Fuller Construction Products, St. Paul, MN or Approved Equal

2. Or approved equal

2.02 MATERIALS / EQUIPMENT

A. Flexible Elastomeric Insulation

1. Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials

B. Flexible Elastomeric Adhesive

1. Comply with MIL-A-24179A, Type II, Class I.

C. Sealants

1. Joint Sealants:

a. Materials shall be compatible with insulation materials, jackets, and substrates.

b. Permanently flexible, elastomeric sealant.

c. Service Temperature Range: Minus one hundred (100) to plus three hundred (300) deg F (Minus seventy-three [73] to plus one hundred and forty-none [149] deg C).

d. Color: White or gray.

2. PVC Jacket Flashing Sealants:

a. Materials shall be compatible with insulation materials, jackets, and substrates.

b. Fire- and water-resistant, flexible, elastomeric sealant.

c. Service Temperature Range: Minus forty (40) to plus two hundred and fifty (250) deg F (Minus forty [40] to plus one hundred twenty-one [121] deg C).

d. Color: White.

D. Field Applied Jackets

1. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

2. 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.

a. Adhesive: As recommended by jacket material manufacturer.

b. Color: White

c. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

1) 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.

E. TAPES

1. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

a. Width: two (2) inches (50 mm).

b. Thickness: six (6) mils (0.15 mm).

c. Adhesion: sixty-four (64) ounces force/inch (0.7 N/mm) in width.

d. Elongation: five hundred (500) percent.

e. Tensile Strength: eighteen (18) lbf/inch (3.3 N/mm) in width.

PART 3 EXECUTION

3.01 INSTALLATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

C. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

D. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

E. 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.

F. Install insulation with longitudinal seams at top and bottom of horizontal runs.

G. Install multiple layers of insulation with longitudinal and end seams staggered.

H. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

I. Keep insulation materials dry during application and finishing.

J. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

K. Install insulation with least number of joints practical.

L. 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.

M. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

N. Cut insulation in a manner to avoid compressing insulation more than seventy-five (75) percent of its nominal thickness.

O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

P. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least four (4) inches (100 mm) beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

Q. 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.

R. 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 two (2) inches (50 mm) below top of roof flashing.

4. Seal jacket to roof flashing with flashing sealant.

S. 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 (2) times the thickness of pipe insulation, or one (1) 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 (2) 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 (2) times the thickness of pipe insulation, or one (1) 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.

T. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. 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.

U. Installation of flexible elastomeric insulation:

1. 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.

2. Insulation Installation on Pipe Flanges:

   a. Install pipe insulation to outer diameter of pipe flange.

   b. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

   c. 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.

   d. 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.

3. Insulation Installation on Pipe Fittings and Elbows:

   a. Install mitered sections of pipe insulation.

   b. 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.

4. Insulation Installation on Valves and Pipe Specialties:

   a. Install preformed valve covers manufactured of same material as pipe insulation when available.

   b. 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.

   c. Install insulation to flanges as specified for flange insulation application.

   d. 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.

V. Field Applied Jacket Installation

1. Where PVC jackets are indicated, install with one (1) inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.

   a. Apply two (2) continuous beads of adhesive to seams and joints, one (1) bead under lap and the finish bead along seam and joint edge.

W. Piping Installation Schedule:

1. Indoor Piping: one inch (1”) Flexible Elastomeric with PVC Jacket

2. Outdoor Piping: two inch (2”) Flexible Elastomeric with PVC Jacket

3.02 FIELD TESTING / QUALITY CONTROL

A. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect the Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three (3) locations of straight pipe, three (3) locations of threaded fittings, three (3) locations of welded fittings, three (3) locations of valves for each pipe service at each Site.

B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

END OF SECTION

SECTION 15400

BASIC PLUMBING REQUIREMENTS

PART 1 GENERAL

1.01. WORK INCLUDED

A. Provide all labor, tools, materials, accessories, parts, transportation, taxes, and related items, essential for installation of the work and necessary to make work, complete, and operational. Provide new equipment and material unless otherwise called for. References to codes, specifications and standards called for in the specification sections and on the drawings mean, the latest edition, amendment and revision of such referenced standard in effect on the date of these Contract Documents.

1.02. LICENSING

A. The Contractor shall hold a license to perform the work as issued by the local jurisdiction.

B. Plumbing work shall be performed by, or under, the direct supervision of a licensed master plumber if so required by the local jurisdiction.

C. The Contractor shall be responsible for reviewing the local jurisdiction requirements prior to bidding.

1.03. PERMITS

A. Apply for and obtain all required permits and inspections, pay all fees and charges including all service charges.

1.04. CODE COMPLIANCE

A. Provide work in compliance with the following:

1. The Building Code of New York State including The Fire Code; Property Maintenance Code; Plumbing Code, Mechanical Code and Fuel Gas Code; and The Energy Code of New York.

2. New York State Department of Labor Rules and Regulations.

3. Occupational Safety and Health Administration (OSHA).

4. National Fuel Gas Code, NFPA 54.

5. National Electrical Code, NFPA 70.

6. Local Codes and Ordinances.

7. Life Safety Codes, NFPA 101 (2015).

8. New York Board of Fire Underwriters.

1.05. GLOSSARY

A. ACI - American Concrete Institute
B. AGA - American Gas Association
C. AGCA - Associated General Contractors of America, Inc.
D. AIA - American Institute of Architects
E. AISC - American Institute of Steel Construction
F. AFBMA - Anti-Friction Bearing Manufacturer's Association
G. AMCA - Air Moving and Conditioning Association, Inc.
H. ANSI - American National Standards Institute
I. ARI - Air Conditioning and Refrigeration Institute
J. ASHRAE - American Society of Heating, Refrigeration, and Air Conditioning Engineers, Inc.
K. ASME - American Society of Mechanical Engineers
L. ASPE - American Society of Plumbing Engineers
M. ASTM - American Society for Testing Materials
N. FM - Factory Mutual Insurance Company
O. IBR - Institute of Boiler & Radiation Manufacturers
P. IEEE - Institute of Electrical and Electronics Engineers
Q. IRI - Industrial Risk Insurers
R. NYBFU - New York Board of Fire Underwriters
S. NEC - National Electrical Code
T. NEMA - National Electrical Manufacturer's Association
U. NESC - National Electrical Safety Code
V. NFPA - National Fire Protection Association
W. NYSDEC - New York State Department of Environmental Conservation
X. SBI - Steel Boiler Institute
Y. SMACNA - Sheet Metal and Air Conditioning Contractors National Association
Z. UFPO - Underground Facilities Protection Organization
AA. UL - Underwriter's Laboratories, Inc.
AB. OSHA - Occupational Safety and Health Administration
AC. NYS/UFPBC - New York State Uniform Fire Prevention and Building Code

1.06. DEFINITIONS

A. Acceptance - Owner acceptance of the project from Contractor upon certification by Owner's Representative.
B. Approval/Approved - Written permission to use a material or system.
C. As Called For - Materials, equipment including the execution specified/shown in the contract documents.
D. Code Requirements - Minimum requirements.
E. Concealed - Work installed in pipe and duct shafts, chases or recesses, inside walls, above ceilings, in slabs or below grade.
F. Design Equipment - Refer to Article 1.09.
G. Design Make - Refer to Article 1.09.
H. Exposed - Work not identified as concealed.
I. Equal or Equivalent - Equally acceptable as determined by Owner's Representative.
J. Furnish - Supply and deliver to installed location.
K. Furnished by Others - Receive delivery at job site or where called for and install.
L. Inspection - Visual observations by Owner's site Representative.
M. Install - Mount and connect equipment and associated materials ready for use.
N. Labeled - Refers to classification by a standards agency.
O. Make - Refer to Article 1.09.
P. Or Approved Equal - Approved equal or equivalent as determined by Owner's Representative.
Q. Owner's Representative - The Prime Professional.

R. Prime Professional - Architect or Engineer having a contract directly with the Owner for professional services.
S. Provide - Furnish, install, and connect ready for use.
T. Relocate - Disassemble, disconnect, and transport equipment to new locations, then clean, test, and install ready for use.
U. Replace - Remove and provide new item.
V. Review - A general contractual conformance check of specified products.
W. Roughing - Pipe, duct, conduit, equipment layout and installation.
X. Satisfactory - As specified in contract documents.
Y. Site Representative - Owner's inspector or "Clerk of Works" at the work site.

1.07. SHOP DRAWINGS/PRODUCT DATA/SAMPLES

A. Submit Shop Drawings on all items of equipment and materials to be furnished and installed. Submission of Shop Drawings and samples shall be accompanied by a transmittal letter, stating name of project and contractor, number of drawings, titles, and other pertinent data called for in individual sections. Shop Drawings shall be dated and contain name of project; name of prime professional; name of prime contractor; description or names of equipment, materials and items; and complete identification of locations at which materials or equipment are to be installed. Individual piecemeal or incomplete submittals will not be accepted. Similar items, (all types specified) shall be submitted at one time. Number each submittal by trade. Indicate deviations from contract requirements on Letter of Transmittal. Shop Drawings will be given a general review only. Corrections or comments made on the Shop Drawings during the review do not relieve Contractor from compliance with requirements of the drawings and specifications. The Contractor is responsible for confirming and correcting all quantities; checking electrical characteristics and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner.

1.08. PROTECTION OF PERSONS AND PROPERTY

A. Contractor shall assume responsibility for construction safety at all times and provide, as part of contract, all trench or building shoring, scaffolding, shielding, dust/fume protection, mechanical/electrical protection, special grounding, safety railings, barriers, and other safety feature required to provide safe conditions for all workmen and site visitors.

1.09. EQUIPMENT ARRANGEMENTS

A. The Contract Documents are prepared on basis of one manufacturer as "design equipment," even though other manufacturer's names are listed as acceptable makes. If Contractor elects to use one of the listed makes other than "design equipment," submit detailed drawings, indicating proposed installation of equipment. Show maintenance arrangement. Make required changes in the work of other trades, at no increase in any contract. Provide larger motors, feeders, breakers, and equipment, additional control devices, valves, fittings and other miscellaneous equipment required for proper operation, and assume responsibility for proper location of roughing and connections by other trades. Remove and replace door frames, access doors, walls, ceilings, or floors required to install other than design make equipment. If revised arrangement submittal is rejected, revise and resubmit specified "design equipment" item which conforms to Contract Documents.

1.10. CONTINUITY OF SERVICES

A. The building will be in use during construction operations. Maintain existing systems in operation within all rooms of building at all times. Refer to General Conditions of the Contract for Construction for temporary facilities for additional contract requirements.

Schedules for various phases of contract work shall be coordinated with all other trades and with Owner's Representative. Provide, as part of contract, temporary mechanical and plumbing connections and relocations as required to accomplish the above. Obtain approval in writing as to date, time, and location for shutdown of existing mechanical/plumbing facilities or services.

1.11. ROUGHING

A. Due to small scale of Drawings, it is not possible to indicate all offsets, fittings, changes in elevation, interferences, etc. Make necessary changes in contract work, equipment locations, etc., as part of a contract to accommodate work to obstacles and interferences encountered. Before installing, verify exact location and elevations at work site. DO NOT SCALE plans. If field conditions, details, changes in equipment or shop drawing information require an important rearrangement, report same to Owner's Representative for review. Obtain written approval for all major changes before installing.

B. Install work so that items both existing and new are operable and serviceable. Eliminate interference with removal of coils, motors, filters, belt guards and/or operation of doors. Provide easy, safe, and code mandated clearances at controllers, motor starters, valve access, and other equipment requiring maintenance and operation. Where Contractor could not reasonably be expected to find such trade interferences due to concealment in walls, ceiling or floors, such relocations will be done by change order, if not, included in contract work. Contractor shall relocate existing work in way of new construction. VISIT SITE BEFORE BIDDING TO DETERMINE SCOPE OF WORK SINCE FEW OF SUCH ITEMS CAN BE SHOWN. Provide new materials, including new piping and insulation for relocated work.

C. Coordinate work with other trades and determine exact route or location of each duct, pipe, conduit, etc., before fabrication and installation. Coordinate with architectural drawings. Obtain from Owner's Representative exact location of all equipment in finished areas, such as thermostat, fixture, and switch mounting heights, and equipment mounting heights. Coordinate all work with the architectural reflected ceiling plans and/or existing Architecture. Mechanical and plumbing drawings show design arrangement only for diffusers, grilles, registers, air terminals, lighting fixtures, speakers, and other items. Do not rough-in contract work without reflected ceiling location plans.

D. Before roughing for equipment furnished by Owner or in other contracts, obtain from Owner and other Contractors, approved roughing drawings giving exact location for each piece of equipment. Do not "rough in" services without final layout drawings approved for construction. Cooperate with other trades to insure proper location and size of connections to ensure proper functioning of all systems and equipment. For equipment and connections provided in this contract, prepare roughing drawing as follows:

1. Existing Equipment - Measure the existing equipment and prepare for installation in new location.

2. New Equipment - Obtain equipment roughing drawings and dimensions, then prepare roughing-in-drawings. If such information is not available in time, obtain an acknowledgement in writing, then make space arrangements as required with Owner's Representative.

1.12. REMOVAL WORK

A. Where existing equipment removals are called for, submit complete list to Owner's Representative all items that Owner wishes to retain that do not contain asbestos or PCB Material shall be delivered to location directed by Owner. Items that Owner does not wish to retain shall be removed from site and legally disposed of. Removal and disposal of material containing asbestos and/or PCB's shall be in accordance with federal, state, and local law requirements. Where equipment is called for to be relocated, contractor shall carefully remove, clean and recondition, then reinstall. Removal all abandoned piping, wiring, equipment, lighting, ductwork, tubing, supports, fixtures, etc. Visit each room, crawlspace, and roof to determine the total scope of work. The disturbance or dislocation of asbestos-containing materials causes asbestos fibers to be released into the building's atmosphere, thereby creating a health hazard to workmen and building occupants. Consistent with Industrial Code Rule 56 and the content of recognized asbestos-control work, the Contractor shall apprise all of his workers, supervisory personnel, subcontractors, Owner and Consultants who will be at the job site of the seriousness of the hazard and of proper safeguards and work procedures which must be followed, as described in New York State Department of Labor Industrial Code Rule 56.

1.13. EQUIPMENT AND MATERIAL INSTALLATION

A. Provide materials that meet the following minimum requirements:

1. Materials shall have a flame spread rating of 25 or less and smoke developed rating of 50 or less, in accordance with NFPA 255.

2. All equipment and material for which there is a listing service shall bear a UL label.

3. Potable water systems and equipment shall be built according to AWWA Standards.

4. Gas-fired equipment and system shall meet AGA Regulations and shall have AGA label.

5. Electrical equipment and systems shall meet UL Standards and requirements of the NEC.

1.14. CUTTING AND PATCHING

A. Each trade shall include their required cutting and patching work unless shown as part of the General Construction work on the architectural drawings. Refer to "General Conditions of the Contract for Construction," for additional requirements. Cut and drill from both sides of walls and/or floors to eliminate splaying. Patch any cut or abandoned holes left by removals of equipment, fixtures, etc. Patch adjacent existing work disturbed by installation of new work including insulation, walls and wall covering, ceiling and floor covering, other finished surfaces. Patch openings and damaged areas equal to existing surface finish. Cut openings in prefabricated construction units in accordance with manufacturer's instructions.

1.15. PAINTING

A. Include painting for patchwork with color to match adjacent surfaces. Where color cannot be adequately matched, paint entire surface. Provide one coat of primer and two finish coats or as called for in the mechanical and electrical specifications. Refer to General Construction Specifications for additional information.

1.16. CONCEALMENT

A. Conceal all contract work above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impractical, notify Owner's Representative before starting that part of the work and install only after his review. In areas with no ceilings, install only after Owner's Representative reviews and comments on arrangement and appearance.

1.17. CHASES

A. New Construction

1. Certain chases, recessed, openings, shafts, and wall pockets will be provided as part of "General Building Construction Plans and Specifications." Mechanical and Electrical Trades work shall provide all other openings required for their contract work.

2. Check Architectural Design and Shop Drawings to verify correct size and location for all openings, recesses and chases in general building construction work.

3. Assume responsibility for correct and final location and size of such openings.

4. Rectify improperly sized, improperly located or omitted chases or openings due to faulty or late information or failure to check final location.

5. Provide 18 gauge galvanized sleeves and inserts. Extend all sleeves 2 inches above finished floor. Set sleeves and inserts in place ahead of new construction, securely fastened during concrete pouring. Correct, by drilling, omitted or improperly located sleeves. Assume responsibility for all work and equipment damaged during course of drilling. Firestop all unused sleeves.

6. Provide angle iron frame where openings are required for contract work, unless provided by General Construction Contractor.

B. In Existing Buildings

1. Drill holes for floor and/or roof slab openings.

2. Multiple pipes smaller than 1 inch properly spaced and supported may pass through one 6-inch or smaller diameter opening.

3. Seal voids in fire rated assemblies with a fire-stopping seal system to maintain the fire resistance of the assembly. Provide 18 gauge galvanized sleeves at fire rated assemblies. Extend sleeves 2 inches above floors.

4. In wall openings, drill or cut holes to suit. Provide 18 gauge galvanized sleeves at shafts and fire rated assemblies. Provide firestopping seal between sleeves and wall in drywall construction. Provide firestopping similar to that for floor openings.

1.18. FLASHING, SEALING, FIRE-STOPPING

A. See Section 15401, Plumbing Firestopping

1.19. SUPPORTS

A. Provide required supports, beams, angles, hangers, rods, bases, braces, and other items to properly support contract work. Supports shall meet the approval of the Owner's Representative. Modify studs, add studs, add framing, or otherwise reinforce studs in metal stud walls and partitions as required to suit contract work. If necessary, in stud walls, provide special supports from floor to structure above. For precast panels/planks and metal decks, support mechanical/electrical work as determined by manufacturer and Owner's Representative. Provide heavy gauge steel mounting plates for mounting contract work. Mounting plates shall span two or more studs. Size, gauge, and strength of mounting plates shall be sufficient for equipment size, weight, and desired rigidity.

1.20. ACCESS PANELS

A. Access panels shall be furnished by the Mechanical and Plumbing Trades and installed by General Contractor. Location and size shall be the responsibility of each trade. Bear cost of construction changes necessary due to improper information or failure to provide proper information in ample time. Access panels over 324 square inches shall have two cam locks. Contractor shall provide proper frame and door type for various wall or ceiling finishes. Access panels shall be equal to "Milcor" as manufactured by Inland Steel Products Co., Milwaukee, Wisconsin. Provide General Contractor with a set of architectural black and white prints with size and approximate locations of access panels shown.

1.21. CONCRETE BASES

A. Provide concrete bases for all floor-mounted equipment (unless otherwise noted). Provide 3,000-lb. concrete, chamfer edges, trowel finish, and securely bond to floor by roughening slab and coating with cement grout. Bases 4 inches high (unless otherwise indicated); shape and size to accommodate equipment. Set anchor bolts in sleeves before pouring and after anchoring and leveling, fill equipment bases with grout.

1.22. PLUMBING EQUIPMENT CONNECTIONS

A. Contractor is responsible for draining, filling, venting, chemically treating and restarting any systems which are affected by work shown on the Contract Documents unless specifically noted otherwise.

B. Provide roughing and final water, waste, vent, propane, etc. connections to all equipment. Provide loose key stops, sanitary "P" traps, tailpiece, adapters, gas cocks, and all necessary piping and fittings from roughing point to equipment. Provide installation of sinks, faucets, traps, tailpiece furnished by others. Provide continuation of piping and connection to equipment that is furnished by others. Provide relief valve discharge piping from equipment relief valves to point(s) of safe discharge.

C. Provide as part of plumbing work valved water outlet adjacent to equipment requiring same. Provide equipment type floor drains, or drain hubs, adjacent to equipment.

D. Install controls and devices furnished by others.

E. Refer to Contract Documents for roughing schedules, and equipment lists indicating scope of connections required.

F. Provide for Owner-furnished and Contractor-furnished equipment all valves, piping, piping accessories, traps, pressure reducing valves, gauges, relief valves, vents, drains, insulation, sheet metal work, controls, dampers, wiring as required.

G. Refer to manufacturer drawings and specifications for requirements of kitchen equipment, laboratory equipment and special equipment. Verify connection requirements before bidding.

1.23. STORAGE AND PROTECTION OF MATERIALS

A. Store materials on dry base, at least 6 inches above ground or floor. Store so as not to interfere with other work or obstruct access to buildings or facilities. Provide waterproof/windproof covering. Remove and provide special storage for items subject to moisture damage. Protect against theft or damage from any cause. Replace items stolen or damaged, at no cost to Owner.

B. Refer to General Conditions of the Contract for Construction.

1.24. FREEZING AND WATER DAMAGE

A. Take all necessary precautions with equipment, systems and building to prevent damage due to freezing and/or water damage. Repair or replace, at no charge in contract, any such damage to equipment, systems, and building. Perform first seasons winterizing in presence of Owner's operating staff.

1.25. OWNER INSTRUCTIONS

A. Before final acceptance of the work, furnish necessary skilled labor to operate all systems by seasons. Instruct designated person on proper operation, and care of systems/equipment. Repeat instructions, if necessary. Obtain written acknowledgement from person instructed prior to final payment. Contractor is fully responsible for system until final acceptance, even though operated by Owner's personnel, unless otherwise agreed in writing. List under clear plastic, operating, maintenance, and starting precautions procedures to be followed by Owner for operating systems and equipment.

1.26. MAINTENANCE MANUALS

A. Prepare Instructions and Maintenance Portfolios. Include one copy of each of approved Shop Drawings, wiring diagrams, piping diagrams spare parts lists, as-built drawings and manufacturer's instructions. Include typewritten instructions, describing equipment, starting/operating procedures, emergency operating instructions, summer-winter changeover, freeze protection, precautions and recommended maintenance procedures. Include name, address, and telephone number of supplier manufacturer representative and service agency for all major equipment items in a three ring binder with name of project on the cover. Deliver to Owner's Representative before request for final acceptance.

1.27. RECORD DRAWINGS

A. The Contractor shall obtain at his expense one set of construction Contract Drawings including non-reproducible black and white prints and one set of reproducible mylars for the purpose of recording record conditions.

B. The Contractor shall perform all survey work required for the location and construction of the work and to record information necessary for completion of the record drawings. Record drawings shall show the actual location of the constructed facilities in the same manner as was shown on the bid drawings. All elevations and dimensions shown on the drawings shall be verified or corrected so as to provide a complete and accurate record of the facilities as constructed.

C. It shall be the responsibility of the Contractor to mark each sheet of the non-reproducible drawings in pencil and to record thereon in a legible manner, any and all approved field changes and conditions as they occur. A complete file of approved field sketches, diagrams, and other changes shall also be maintained. At completion of the work, each sheet of record prints, plus all approved field sketches and diagrams shall be used in preparation of the mylar reproducible record drawings.

D. Completed reproducible mylar drawings shall be certified as reflecting record conditions and submitted to the Engineer for approval.

1.28. ADDITIONAL ENGINEERING SERVICES

A. In the event that the consultant is required to provide additional engineering services as a result of substitution of equivalent materials or equipment by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the consultant is required to examine and evaluate any changes proposed by the Contractor for the convenience of the Contractor, then consultant's expenses in connection with such additional services shall be paid by the Contractor and may be deducted from any monies owed to the Contractor.

1.29. FINAL INSPECTION

A. Upon completion of all punch list items, the Contractor shall provide a copy of the punch list back to the Engineer with each items noted as completed or the current status of the item. Upon receipt, the Engineer will schedule a final inspection.

1.30. ALL TRADES TEMPORARY HEAT

A. Refer to the Standard General Conditions of the Contract for Construction and Supplementary General Conditions.

1.31. PLUMBING TEMPORARY FACILITIES

A. Refer to the Standard General Conditions of the Contract for Construction and Supplementary General Conditions.

1.32. CLEANING

A. It is the Contractor's responsibility to keep clean all equipment and fixtures provided under this contract for the duration of the project. Each trade shall keep the premises free from an accumulation of waste material or rubbish caused by his operations. The facilities require an environment of extreme cleanliness, and it is the Contractor's responsibility to adhere to the strict regulations regarding procedures on the existing premises. After all tests are made and installations completed satisfactorily:

B. Thoroughly clean entire installation, both exposed surfaces and interiors.

C. Remove all debris caused by work.

D. Remove tools, surplus, materials, when work is finally accepted.

END OF SECTION

SECTION 15401

PLUMBING FIRESTOPPING

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Firestopping materials.

B. Firestopping of all penetrations, openings, and interruptions to fire rated assemblies, whether indicated on drawings or not, including but not limited to piping, tubing and similar utilities passing through or penetrating fire rated walls and floor assemblies.

1.02. REFERENCES

A. ASTM International

1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

B. National Fire Protection Association

1. NFPA 70 - National Electrical Code.

C. Underwriters Laboratories Inc.

1. UL 263 - Fire Tests of Building Construction and Materials.

2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

3. UL 1479 - Fire Tests of Through-Penetration Firestops.

4. UL - Fire Resistance Directory.

D. Plumbing and Fuel Gas Codes of New York State.

1.03. FIRESTOP SYSTEM PERFORMANCE REQUIREMENTS

A. General - For penetrations through fire resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire resistance rating of construction penetrated.

1. Fire resistance-rated walls including fire walls, fire partitions, fire barriers, and smoke barriers.

2. Fire resistance-rated horizontal assemblies including floors and ceiling membranes of roof/ceiling assemblies.

1.04. SUBMITTALS

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

1.05. QUALITY ASSURANCE

A. Fire Testing - Provide firestopping assemblies of designs which provide the specified fire ratings when tested in accordance with methods indicated.

1. Listing in the current-year classification or certification books of UL will be considered as constituting an acceptable test report.

1.06. ENVIRONMENTAL REQUIREMENTS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for three days after installation of materials.

PART 2 PRODUCTS

2.01. MANUFACTURERS

A. Hilti.

B. Nelson Fire Stop Products.

C. Specified Technology.

D. 3M Fire Protection Products.

E. Approved equals meeting UL requirements.

2.02. MATERIALS

A. Sealant Firestopping

1. Intumescent firestop sealant designed to expand when exposed to fire.

2. Paintable.

3. Fire Resistance - Up to four hours.

4. Curing Time - 14 to 21 days.

5. Elongation - 5 percent.

6. Density - 1.5 g/cm^3.

7. Product - FS-ONE Intumescent Firestop Sealant manufactured by Hilti USA.

8. Uses - Insulated and uninsulated metal pipes, with or without sleeve and plastic pipes.

B. Silicone Sealant Firestopping

1. Silicone based firestop sealant that provides maximum movement in fire-rated joint applications and pipe penetrations.

2. Not paintable.

3. Fire Resistance - Up to four hours.

4. Elongation - 25 percent.

5. Product - CP 601S Elastomeric Firestop Sealant manufactured by Hilti USA.

6. Uses - Joints in walls, floor to floor or fire compartments.

C. Safing Insulation

1. Mineral-wool type insulation.

2. Thickness - 1 inch to 1-1/2 inches.

3. Density - 4 to 8 pcf.

4. Product - THERMAFIBER Safing Insulation

D. Sleeves - Provide sleeves as required by Section 1206.4 of the Mechanical Code.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.02. PREPARATION

A. Surface Cleaning - Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.

2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.

3. Remove laitance and form-release agents from concrete.

B. Priming - Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.03. INSTALLATION

A. General - Install materials in manner described in UL detail and in accordance with manufacturer's instructions, completely closing openings.

B. Installation

1. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping and other items, requiring firestopping.

2. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

3. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.

4. Fire-Rated Surface

a. Seal opening at floor, wall, partition, and roof as follows:

1) Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.

2) Size sleeve allowing minimum of 1 inch void between sleeve and building element.

3) Pack void with backing material.

4) Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

b. Where plumbing piping penetrates a fire rated surface, install firestopping product in accordance with manufacturer's instructions.

5. Non-Rated Surfaces

a. Seal opening through non-fire rated wall, floor, ceiling, and roof opening as follows:

1) Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.

2) Size sleeve allowing minimum of 1-inch void between sleeve and building element.

3) Install type of firestopping material recommended by manufacturer.

b. Install floor plates or ceiling plate where piping penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.

c. Exterior Wall Openings Below Grade - Assemble rubber links of mechanical seal to size of piping and tighten in place, in accordance with manufacturer's instructions.

C. Identification - Identify through-penetration firestop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of edge of the firestop systems so that labels will be visible to anyone seeking to remove penetrating items or firestop systems. Use mechanical fasteners for metal labels. For plastic labels, use self-adhering type with adhesives capable of permanently bonding labels to surfaces on which labels are placed and, in combination with label material, will result in partial destruction of label if removal is attempted. Include the following information on labels:

1. The words "Warning - Through-Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."

2. Date of installation.

3. Through-penetration firestop system manufacturer's name.

3.04. CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

END OF SECTION

SECTION 15402

PLUMBING IDENTIFICATION

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Nameplates.

B. Pipe markers.

1.02. REFERENCE STANDARDS

A. ASME A13.1 - Scheme for the Identification of Piping Systems; The American Society of Mechanical Engineers; 2007.

1.03. SUBMITTALS

A. Product Data - Provide manufacturers' catalog literature for each product required.

PART 2 PRODUCTS

2.01. MANUFACTURERS

A. Seton Identification Products.

B. Brady Corporation.

C. Emed Company.

D. Approved Equal.

2.02. NAMEPLATES

A. Description - Laminated three-layer plastic with engraved letters.

1. Letter Color - White.

2. Letter Height - 3/8 inch.

3. Nameplate Height - 3/4 inch.

4. Background Color - Black.

2.03. PIPE MARKERS AND ACCESSORIES

A. Snap-on Marker - One piece wrap around type constructed of precoiled acrylic plastic with clear polyester coating, integral flow arrows, legend printed in alternating directions, 3/4-inch adhesive strip on inside edge, and 360-degree visibility.

B. Strap-on Marker - Strip type constructed of precoiled acrylic plastic polyester coating, integral flow arrows, legend printed in alternating directions, factory applied grommets, and pair of stainless steel spring fasteners.

C. Stick-on Marker - Pressure sensitive adhesive backed type constructed of vinyl with clear polyester coating, and integral flow arrows for applications where flow arrow banding tape is not being used.

D. Pipe Marker Legend

1. Outside Diameter of Pipe or Insulation 3/4 to 1-1/4 inch

a. Letter Size - 1/2 inch.

b. Length of Color Field 0 8 inches.

2. Outside Diameter of Pipe or Insulation 1-1/2 to 2 inches

a. Letter Size - 3/4 inch.

b. Length of Color Field - 8 inches.

3. Outside Diameter of Pipe or Insulation 2-1/2 to 6 inches

a. Letter Size - 1-1/4 inch.

b. Length of Color Field - 12 inches.

4. Outside Diameter of Pipe or Insulation 8 inches and Greater

a. Letter Size - 2-1/2 inch.

b. Length of Color Field - 18 inches.

E. Color - Conform to ANSI A13.1.

F. Banding Tapes - Pressure sensitive adhesive backed type constructed of vinyl with clear polyester coating.

1. Plain Tape - Unprinted type; color to match pipe marker background.

2. Flow Arrow Tape - Printed type with integral flow arrows; color to match pipe marker background.

2.04. UNDERGROUND PLASTIC PIPE MARKERS

A. Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

PART 3 EXECUTION

3.01. PREPARATION

A. Complete testing, insulation, and finish painting work prior to completing the Work of this Section.

B. Clean pipe and equipment surfaces with cleaning solvents prior to installing piping identification or equipment tags.

C. Remove dust from insulation surfaces with clean clothes prior to installing piping or equipment identification.

3.02. INSTALLATION

A. Install the work of this section in accordance with the manufacturer's printed installation instructions, unless otherwise specified.

B. Nameplates - Install plastic nameplates on properly prepared and dry surface with adhesive and ensure permanent adhesion.

C. Stick-On Pipe Markers

1. Install minimum of two markers at each specified location, 90 degrees apart on visible side of pipe.

2. Encircle ends of pipe markers around pipe or insulation with banding tape with 1-inch lap. Use plain banding tape on markers with integral flow arrows, and flow arrow banding tape on markers without integral flow arrows.

D. Underground Plastic Pipe Markers - Install 6 to 8 inches below finished grade, directly above buried pipe.

3.03. PIPING IDENTIFICATION

A. Piping Identification Types

1. Piping or insulation under 3/4 inch OD - Pipe identification tags.

2. Piping or insulation 1 inch and larger - Snap-on pipe markers or stick-on pipe markers.

B. Identify exposed piping, bare or insulated, as to content and direction of flow, with the following exceptions:

1. Piping in non-walk-in tunnels or underground conduits between manholes.

2. Piping in furred spaces or suspended ceilings, except at valve access panels where valves and piping shall be identified as specified for exposed piping systems.

3. Piping exposed in finished spaces such as offices, classrooms, wards, toilet rooms, shower rooms, and corridors.

C. Locate piping identification to be visible from exposed points of observation.

1. Locate piping identification at valve locations; at points where piping enters and leaves a partition, wall, floor or ceiling, and at intervals of 20 feet on straight runs.

2. Where two or more pipes run in parallel, place printed legend and other markers in same relative location.

3.04. EQUIPMENT IDENTIFICATION

A. Identify uninsulated plumbing equipment by means of plastic nameplates.

1. Letter Size - 3/8 inches height.

B. Small in-line pumps may be identified with tags equivalent as specified for pipe service.

C. Locations - Co-locate nameplates with manufacturer's equipment nameplates where readily visible. Where view of manufacturers nameplate is obstructed locate nameplate to be readily visible.

D. Equipment Identification Legend - Equipment identification shall match tags as scheduled on drawings.

END OF SECTION

SECTION 15410

PLUMBING PIPING

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Pipe, pipe fittings, valves, and connections for piping systems.

1. Sanitary sewer.

2. Domestic water.

1.02. REFERENCE STANDARDS

A. ANSI Z21.22 - American National Standard for Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems; 1999, and addenda A&B (R2004).

B. ASME B16.3 - Malleable Iron Threaded Fittings; The American Society of Mechanical Engineers; 1998 (R2006).

C. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2001 (R2005) (ANSI B16.18).

D. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2001 (R2005).

E. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV; The American Society of Mechanical Engineers; 2002.

F. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV; The American Society of Mechanical Engineers; 2007.

G. ASME B31.1 - Power Piping; The American Society of Mechanical Engineers; 2007 (ANSI/ASME B31.1).

H. ASME B31.9 - Building Services Piping; The American Society of Mechanical Engineers; 2008 (ANSI/ASME B31.9).

I. ASTM A 234/A 234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2007.

J. ASTM B 32 - Standard Specification for Solder Metal; 2008.

K. ASTM D 1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2006.

L. ASTM D 2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series); 2009.

M. ASTM D 2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2006.

N. ASTM D 2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2004 (Reapproved 2009).

O. ASTM D 2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2009.

P. ASTM D 2846/D 2846M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems; 2009b.

Q. ASTM D 2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings; 1996 (Reapproved 2002).

R. ASTM D 3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2008.

S. ASTM F 437 - Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2009.

T. ASTM F 438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40; 2009.

U. ASTM F 439 - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80; 2009.

V. ASTM F 441/F 441M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80; 2009.

W. ASTM F 442/F 442M - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR); 2009.

X. ASTM F 493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings; 2004.

Y. AWWA C651 - Disinfecting Water Mains; American Water Works Association; 2005 (ANSI/AWWA C651).

Z. MSS SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacture; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2009.

AA. MSS SP-67 - Butterfly Valves; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2002a.

AB. MSS SP-69 - Pipe Hangers and Supports - Selection and Application; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2003.

AC. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 2008.

AD. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.; 1996.

1.03. SUBMITTALS

A. Product Data - Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.04. QUALITY ASSURANCE

A. Perform work in accordance with State of New York standards.

1. Maintain one copy on project site.

B. Valves - Manufacturer's name and pressure rating marked on valve body.

C. Welding Materials and Procedures - Conform to ASME (BPV IX) and applicable state labor regulations.

D. Welder Qualifications - Certified in accordance with ASME (BPV IX).

E. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.05. REGULATORY REQUIREMENTS

A. Perform work in accordance with State of New York Plumbing Code.

B. Conform to applicable code for installation of backflow prevention devices.

C. Provide certificate of compliance from authority having jurisdiction indicating approval of installation of backflow prevention devices.

1.06. DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07. FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01. SANITARY SEWER PIPING, ABOVE GRADE

A. Cast Iron Pipe - ASTM A 74, service weight.

1. Fittings - Cast iron.

2. Joint Seals - ASTM C 564 neoprene gaskets.

B. Cast Iron Pipe - CISPI 301, hubless, service weight.

1. Fittings - Cast iron.

2. Joints - CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.

C. PVC Pipe - ASTM D 2665.

1. Fittings - PVC.

2. Joints - Solvent welded, with ASTM D 2564 solvent cement.

2.02. WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Copper Pipe - ASTM B 42, hard drawn.

1. Fittings - ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.

2. Joints - ASTM B 32, alloy Sn95 solder.

2.03. POTABLE WATER PIPING, ABOVE GRADE

A. Copper Tube - ASTM B 88 (ASTM B 88M), Type L (B), Drawn (H).

1. Fittings - ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.

2. Joints - ASTM B 32, alloy Sn95 solder.

B. CPVC Pipe - ASTM D 1785 or ASTM D 2241.

1. Fittings - ASTM D 2665, CPVC.

2. Joints - ASTM D 2846/D 2846M, solvent weld with ASTM F 493 solvent cement.

C. PVC Pipe - ASTM D 1785 or ASTM D 2241.

1. Fittings - ASTM D 2665, PVC.

2. Joints - ASTM D 2846/D 2846M, solvent weld with ASTM F 493 solvent cement.

2.04. FLANGES, UNIONS, AND COUPLINGS

A. Unions for Ferrous Pipe Sizes 3 inches and Under - Class 150 malleable iron threaded unions.

B. Unions for Copper Tube and Pipe 2 inches and Under - Class 150 bronze unions with soldered joints.

C. Flanges for Pipe Size Over 1 inch

1. Ferrous Pipe - Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.

2. Copper Tube and Pipe - Class 150 slip-on bronze flanges; preformed neoprene gaskets.

D. Dielectric Connections - Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.05. PIPE HANGERS AND SUPPORTS

A. All plumbing piping shall be supported in accordance with the Plumbing Code of New York State. Hangers, anchors and supports shall support the piping and the contents of the piping. Hangers and strapping shall be of approved material that will not promote galvanic action.

B. Plumbing Piping - Drain, Waste, and Vent

1. Conform to ASME B31.9.

2. Hangers for Pipe Sizes 1/2 inch to 1-1/2 inches - Malleable iron, adjustable swivel, split ring.

3. Hangers for Pipe Sizes 2 inches and Over - Carbon steel, adjustable, clevis.

4. Multiple or Trapeze Hangers - Steel channels with welded spacers and hanger rods.

5. Wall Support for Pipe Sizes to 3 inches - Cast iron hook.

6. Wall Support for Pipe Sizes 4 inches and Over - Welded steel bracket and wrought steel clamp.

7. Vertical Support - Steel riser clamp.

8. Floor Support - Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

9. Copper Pipe Support - Carbon steel ring, adjustable, copper plated.

C. Plumbing Piping - Water

1. Conform to ASME B31.9.

2. Hangers for Pipe Sizes 1/2 inch to 1-1/2 inches - Malleable iron, adjustable swivel, split ring.

3. Hangers for Cold Pipe Sizes 2 inches and Over - Carbon steel, adjustable, clevis.

4. Hangers for Hot Pipe Sizes 2 inches to 4 inches - Carbon steel, adjustable, clevis.

5. Hangers for Hot Pipe Sizes 6 inches and Over - Adjustable steel yoke, cast iron pipe roll, double hanger.

6. Multiple or Trapeze Hangers - Steel channels with welded supports or spacers and hanger rods.

7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches and Over - Steel channels with welded supports or spacers and hanger rods, cast iron roll.

8. Wall Support for Pipe Sizes to 3 inches - Cast iron hook.

9. Wall Support for Pipe Sizes 4 inches and Over - Welded steel bracket and wrought steel clamp.

10. Wall Support for Hot Pipe Sizes 6 inches and Over - Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron pipe roll.

11. Vertical Support - Steel riser clamp.

12. Floor Support for Cold Pipe - Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

13. Floor Support for Hot Pipe Sizes to 4 inches - Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.

14. Floor Support for Hot Pipe Sizes 6 inches and Over - Adjustable cast iron pipe roll and stand, steel screws, and concrete pier or steel support.

15. Copper Pipe Support - Carbon steel ring, adjustable, copper plated.

D. All pipe hangers and supports in wet, corrosive, hazardous, or exterior locations shall have stainless steel support rods, stainless steel mounting hardware, stainless steel fasteners, and stainless steel concrete inserts. All non-stainless steel parts of the hangers and supports shall be PVC coated.

2.06. GATE VALVES

A. Manufacturers:

1. Conbraco Industries - www.conbraco.com.

2. Nibco, Inc - www.nibco.com.

3. Milwaukee Valve Company - www.milwaukeevalve.com.

4. Approved Equal.

B. Up To and Including 3 inches - MSS SP-80, Class 125, bronze body, bronze trim, rising stem, handwheel, inside screw, solid wedge disc, solder ends.

C. 2 inches and Larger - MSS SP-70, Class 125, iron body, bronze trim, outside screw and yoke, handwheel, solid wedge disc, flanged ends. Provide chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

2.07. GLOBE VALVES

A. Manufacturers

1. Conbraco Industries - www.conbraco.com.

2. Nibco, Inc - www.nibco.com.

3. Milwaukee Valve Company - www.milwaukeevalve.com.

4. Approved Equal.

B. Up To and Including 3 inches - MSS SP-80, Class 125, bronze body, bronze trim, handwheel, bronze disc, solder ends.

C. 2 inches and Larger - MSS SP-85, Class 125, iron body, bronze trim, handwheel, outside screw and yoke, renewable bronze plug-type disc, renewable seat, flanged ends. Provide chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

2.08. BALL VALVES

A. Manufacturers

1. Conbraco Industries - www.conbraco.com.

2. Nibco, Inc - www.nibco.com.

3. Milwaukee Valve Company - www.milwaukeevalve.com.

4. Approved Equal.

B. Construction, 4 inches and Smaller - MSS SP-110, Class 150, 400 psi CWP, bronze, two piece body, chrome plated brass ball, full port, Teflon seats and stuffing box ring, blow-out proof stem, lever handle with balancing stops, solder ends with union.

2.09. BUTTERFLY VALVES

A. Manufacturers

1. Hammond Valve - www.hammondvalve.com.

2. Crane Co. - www.cranevalve.com.

3. Milwaukee Valve Company - www.milwaukeevalve.com.

4. Approved Equal.

B. Construction 1-1/2 inches and Larger - MSS SP-67, 200 psi CWP, cast or ductile iron body, nickel-plated ductile iron disc, resilient replaceable EPDM seat, wafer ends, extended neck, 10 position lever handle.

C. Provide gear operators for valves 8 inches and larger, and chain-wheel operators for valves mounted over 8 feet above floor.

2.10. SWING CHECK VALVES

A. Manufacturers

1. Hammond Valve - www.hammondvalve.com.

2. Nibco, Inc - www.nibco.com.

3. Milwaukee Valve Company - www.milwaukeevalve.com.

4. Approved Equal.

B. Up to 2 inches - MSS SP-80, Class 125, bronze body and cap, bronze swing disc with rubber seat, solder ends.

C. Over 2 inches - MSS SP-71, Class 125, iron body, bronze swing disc, renewable disc seal and seat, flanged or grooved ends.

2.11. SPRING-LOADED CHECK VALVES

A. Manufacturers

1. Hammond Valve - www.hammondvalve.com.

2. Crane Co. - www.cranevalve.com.

3. Milwaukee Valve Company - www.milwaukeevalve.com.

4. Approved Equal.

B. Class 125, iron body, bronze trim, stainless steel springs, bronze disc, Buna N seals, wafer style ends.

2.12. RELIEF VALVES

A. Pressure Relief

1. Manufacturers

a. Cla-Val Co - www.cla-val.com.

b. Henry Technologies - www.henrytech.com.

c. Watts Regulator Company - www.wattsregulator.com.

d. Approved Equal.

2. AGA Z21.22 certified, bronze body, Teflon seat, steel stem and springs, automatic, direct pressure actuated.

B. Temperature and Pressure Relief

1. Manufacturers

a. Cla-Val Co - www.cla-val.com.

b. Henry Technologies - www.henrytech.com.

c. Watts Regulator Company - www.wattsregulator.com.

d. Approved Equal.

2. AGA Z21.22 certified, bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME (BPV IV) certified and labelled.

2.13. STRAINERS

A. Manufacturers

1. Armstrong International, Inc - www.armstronginternational.com.

2. Green Country Filtration - www.greencountryfiltration.com.

3. WEAMCO - www.weamco.com.

4. Approved Equal.

B. Size 2 inch and Under

1. Threaded brass body for 175 psi CWP, Y pattern with 1/32-inch stainless steel perforated screen.

2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32-inch stainless steel perforated screen.

C. Size 1-1/2 inch to 4 inch - Class 125, flanged iron body, Y pattern with 1/16-inch stainless steel perforated screen.

D. Size 5 inch and Larger - Class 125, flanged iron body, basket pattern with 1/8-inch stainless steel perforated screen.

2.14. PIPING SCHEDULE

A. Provide piping in accordance with the following schedule or as otherwise noted on the Drawings:

Application (Unclassified, Dry Areas)	Sizes	Pipe	Joint
Water (Potable and Non-Potable)	3” or less	L copper	Soldered
Water (Potable and Non-Potable)	Above 3”	Ductile Iron	Flanged

Application (Process Areas)	Sizes	Pipe	Joint
Water (Potable, Non-Potable, Plant Water)	Above 3”	Ductile Iron	Flanged
Plant Water	3” or less	PVC Schedule 80	Solvent
Non-Potable Water	3” or less	PVC Schedule 80	Solvent
Domestic Hot, Tempered, and Cold Potable Water	3” or less	CPVC Schedule 80	Solvent
Tempered Water - Plant	3” or less	CPVC Schedule 80	Solvent

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02. PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.03. INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom, conserve space, and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 15411, Plumbing Supply Insulation.

H. Provide access where valves and fittings are not exposed.

I. Install vent piping penetrating roofed areas to maintain integrity of roof assembly. Terminate at least 18 inches above roof.

J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.

K. Provide support for utility meters in accordance with requirements of utility companies.

L. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09900, Painting.

M. Excavate in accordance with Section 02222, Excavating.

N. Backfill in accordance with Section 02223, Backfilling.

O. Install bell and spigot pipe with bell end upstream.

P. Install valves with stems upright or horizontal, not inverted.

Q. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.

R. Use non-hardening pipe dope on gas piping threads; do not use thread seal tape.

S. PVC Pipe - Make solvent-welded joints in accordance with ASTM D 2855.

T. Sleeve pipes passing through partitions, walls and floors.

U. Inserts

1. Provide inserts for placement in concrete formwork.

2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

V. Pipe Hangers and Supports

1. Support horizontal piping as scheduled.

2. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.

3. Place hangers within 12 inches of each horizontal elbow.

4. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

5. Support vertical piping as scheduled.

6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

7. Provide copper plated hangers and supports for copper piping.

8. Prime coat exposed steel hangers and supports. Refer to Section 09900, Painting. Hangers and supports located in crawlspaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

9. Provide hangers adjacent to motor driven equipment with vibration isolation.

10. Support cast iron drainage piping at every joint.

3.04. APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

C. Install gate or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

D. Install globe valves for throttling, bypass, or manual flow control services.

E. Provide lug end butterfly valves adjacent to equipment when provided to isolate equipment.

F. Provide spring loaded check valves on discharge of water pumps.

G. Provide plug valves in natural gas systems for shut-off service.

3.05. TOLERANCES

A. Drainage Piping - Establish invert elevations within 1/2 inch vertically of location indicated and slope to drain at minimum of 1/4 inch per foot slope for pipes 2-1/2-inch diameter and less, 1/8 inch per foot slope for pipes 3 to 6 inches in diameter and 1/16 inch per foot slope for pipes 8 inches and larger in diameter.

B. Water Piping - Slope at minimum of 1/32 inch per foot and arrange to drain at low points with capped drain valves.

3.06. TESTING AND INSPECTIONS

A. New plumbing systems and parts of existing systems that have been altered, extended or repaired shall be tested in accordance with the Plumbing Code of New York State or the authority having jurisdiction to disclose leaks and defects.

B. Pressure test piping systems inside buildings, at the roughing-in stage of installation, before piping is enclosed by construction work, and at other times as directed. Perform test operations in sections as required and directed, to progress the work in a satisfactory manner and not delay the general construction of the building. Valve or cap-off sections of piping to be tested, utilizing valves required to be installed in the permanent piping systems, or temporary valves or caps as required to perform the work.

C. The Contractor shall make the applicable tests prescribed below to determine compliance with the provisions of the Plumbing Code of New York State. The Contractor shall give reasonable advance notice to the code official when the plumbing work is ready for tests. The equipment, material, power and labor necessary for the inspection and test shall be furnished by the Contractor. All plumbing system piping shall be tested with either water or air. Plastic piping shall not be tested with air.

D. Piping shall be tight under test and shall not show loss in pressure or visible leaks, during test operations or after the minimum duration of time as specified. Remove piping which is not tight under test; remake joints and repeat test until no leaks occur.

E. Required Inspections - Final inspection shall be made after the building is completed, all plumbing fixtures are in place and properly connected, and the structure is ready for occupancy.

F. Domestic Water (Potable Cold, Domestic Hot and Recirculation) Inside Buildings

1. Before fixtures, faucets, trim and accessories are connected, perform hydrostatic test at 125 psig minimum for 4 hours.

2. After fixtures, faucets, trim and accessories are connected, perform hydrostatic retest at 75 psig for 4 hours.

3. The water utilized for the tests shall be obtained from a potable water source of supply.

G. Inspection and Testing of Backflow Prevention Assemblies

1. Backflow prevention assemblies shall be tested at the time of installation and immediately after repairs or relocation.

2. The testing procedure shall be performed in accordance with one of the following standards:

a. ASSE Series 5000 - Standards 5013, 5015, 5020, 5047, 5052 or 5056.

3.07. DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. New and repaired potable water systems shall be purged of deleterious matter and disinfected prior to utilization.

B. The method to be followed for the disinfection of potable water systems shall be in accordance with the applicable NYSDOH regulations.

1. Completely fill the piping, including water storage equipment if installed, with a water solution containing 50 mg/L available chlorine and allow to stand for 24 hours. Operate all valves during this period to ensure their proper disinfection. After the 24-hour period, the chlorine residual shall be 25 mg/L or greater. If not, flush and repeat chlorination procedure.

2. After the retention period, discharge the solution into an approved waste and flush the system thoroughly with potable water until substantially all traces of chlorine are removed. Drain and flush water storage equipment if installed.

C. Collect samples for bacteriological analysis in accordance with AWWA C651.

D. Repeat procedure if bacteriological results are not satisfactory.

E. Submit bacteriological test results to the Architect/Engineer prior to placing the system in service. Prevent re-contamination of the piping during this phase of the work.

3.08. SCHEDULES

A. Pipe Hanger Spacing

1. CPVC Pipe or Tubing

a. 1-inch Diameter and Smaller

1) Maximum Horizontal Spacing - 3 feet.
2) Maximum Vertical Spacing - 10 feet. (midstory guide for sizes 2 inches and smaller).

b. 1-1/4-inch Diameter and Larger

1) Maximum Horizontal Spacing - 4 feet.
2) Maximum Vertical Spacing - 10 feet. (midstory guide for sizes 2 inches and smaller).

2. PVC Pipe - All Sizes

   a. Maximum Horizontal Spacing - 4 feet.

   b. Maximum Vertical Spacing - 10 fee (midstory guide for sizes 2 inches and smaller).

3. Cast Iron Piping - All Sizes

   a. Maximum Horizontal Spacing - 5 feet. (may be increased to 10 feet where 10-foot pipe lengths are installed)

   b. Maximum Vertical Spacing – 15 feet.

4. Copper or Copper-Alloy Tubing.

   a. 1-1/4 inch Diameter and Smaller

      1) Maximum Horizontal Spacing - 6 feet.
      2) Maximum Vertical Spacing - 10 feet.

   b. 1-1/2-inch Diameter and Larger

      1) Maximum Horizontal Spacing - 10 feet.
      2) Maximum Vertical Spacing - 10 feet.

5. Steel Piping - All Sizes

   a. Maximum Horizontal Spacing - 12 feet.

   b. Maximum Vertical Spacing - 15 feet.

B. The materials of construction for all hangers and supports shall be in accordance with the following:

Area	Acceptable Materials
EXTERIOR:	
Exposed to Outdoor Conditions, Inside Tanks, Submerged Locations Unless Otherwise Specified	Stainless Steel
Inside Tanks	
Submerged Locations Unless Otherwise Specified	
INTERIOR:	
Corrosive or Wet/Corrosive Areas (either Unclassified or Hazardous)	
Interior Sodium Hypochlorite Storage and Feed Areas	FRP
Unclassified, Unclassified/Wet Areas	
Pump Room	Stainless Steel
Piping Galleries	
Below-Grade Vaults, Manholes, and Handholes	
Polymer Storage and Feed Areas	
Hazardous, Hazardous/Wet Areas	
NEC Class I, Division 1 or 2, Groups C and D	Stainless Steel

END OF SECTION

SECTION 15411

PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.02. REFERENCE STANDARDS

A. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2007.

B. ASTM C 177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus; 2004.

C. ASTM C 195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007.

D. ASTM C 449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007.

E. ASTM C 518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2004.

F. ASTM C 533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation; 2009.

G. ASTM C 534/C 534M - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form; 2008.

H. ASTM C 547 - Standard Specification for Mineral Fiber Pipe Insulation; 2007.

I. ASTM C 610 - Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation; 2009.

J. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2010.

K. ASTM E 96/E 96M - Standard Test Methods for Water Vapor Transmission of Materials; 2005.

L. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.

M. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.03. SUBMITTALS

A. Product Data - Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.04. QUALITY ASSURANCE

A. Manufacturer Qualifications - Company specializing in manufacturing the products specified in this section with not less than five years of documented experience.

B. Applicator Qualifications - Company specializing in performing the type of work specified in this section with minimum five years of documented experience.

C. Regulatory Requirements - Insulation installed inside buildings, including laminated jackets, mastics, sealants and adhesives shall have a Fire Spread/Smoke Developed Rating of 25/50 or less based on ASTM E 84, NFPA 255, and UL 723.

1.05. DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.06. FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01. PIPING INSULATION

A. Fibrous Glass (Mineral Fiber) Insulation - Composed principally of fibers manufactured from rock, slag, or glass, with or without binders, and asbestos free.

1. Manufacturers

a. Johns Manville Corporation.

b. Knauf Fiber Glass.

c. Owens Corning Corporation.

2. Preformed Pipe Insulation - Minimum density 3 pcf; ASTM C 547.

a. Class 1 (Suitable for Temperatures Up to 450 degrees F) - 'K' value of 0.26 at 75 degrees F.

3. Premolded Fitting Insulation - Minimum density 4.0 pcf, K of 0.26 at 75 degrees F; ASTM C 547, Class 1.

4. Insulation Inserts for PVC Fitting Jackets - Minimum density 1.5 pcf, K of 0.28 at 75 degrees F; ASTM C 553, Type III.

a. Suitable for temperatures up to 450 degrees F.

B. Flexible Elastomeric Foam Insulation

1. Manufacturers

a. Armacell Engineered Foams.

b. Rubatex Corporation.

c. Enviro-tec Corporation.

2. Preformed Pipe and Fitting Insulation - ASTM C 534, Type I.

3. FM tested and approved, meeting the following:

a. Maximum Water Vapor Transmission - 0.10 perm-inch based on ASTM E 96, Procedure A.

b. K of 0.27 at 75 degrees F based on ASTM C 518 or C 177.

c. Fire Spread/Smoke Developed Rating - 25/50 or less based on ASTM E 84.

4. Polyethylene and polyolefin insulation is not acceptable.

C. High Density Jacketed Insulation Inserts for Hangers and Supports

1. Manufacturers

a. Johns Manville Corporation.

b. Knauf Fiber Glass.

c. Owens Corning Corp.

2. For Use with Fibrous Insulation

a. Cold Service Piping

1) Polyurethane Foam - Minimum density 4 pcf, K of 0.13 at 75 degrees F, minimum compressive strength of 125 psi.

b. Hot Service Piping

1) Calcium Silicate - Minimum density of 15 pcf, K of 0.50 at 300 degrees F; ASTM C 610.

2) Perlite - Minimum density 12 pcf, K of 0.60 at 300 degrees F; ASTM C610.

3. For Use with Flexible Elastomeric Foam Insulation - Hardwood dowels and blocks, length or thickness equal to insulation thickness, other dimensions as required.

D. Cements

1. Fibrous Glass Thermal Insulating Cement - Asbestos free; ASTM C 195.

2. Fibrous Glass Hydraulic Setting Thermal Insulating and Finishing Cement - ASTM C 449/C 449M.

2.02. INSULATION JACKETS AND FITTING COVERS

A. Laminated Vapor Barrier Jackets for Piping Insulation - Factory applied by insulation manufacturer, conforming to ASTM C 1136, Type I.

1. Type I - Reinforced white kraft and aluminum foil laminate with kraft facing out.

a. Pipe Jackets - Furnished with integral 1-1/2 inch self-sealing longitudinal lap, and separate 3 inch wide adhesive backed butt strips.

2. Type II - Reinforced aluminum foil and kraft laminate with foil facing out.

3. Laminated vapor barrier jackets are not required for flexible elastomeric foam insulation.

B. Canvas Jacket - Cotton duck, fire retardant, complying with NFPA 701, 4 oz/sq yd. or 6 oz/sq yd as specified.

C. Premolded PVC Fitting Jackets

1. Constructed of high impact, UV-resistant PVC.

a. ASTM D 1784, Class 14253-C.

b. Working Temperature - 0 to 150 degrees F.

D. Metal Jacketing

1. Aluminum Jacket - ASTM B 209 (ASTM B 209M) formed aluminum sheet, Type 1100, 3003, 3105, or 5005, Temper H14.

a. Factory Pre-formed Sectional Pipe Jacketing

1) Thickness - 0.016 inch.

2) Finish - Smooth outer finish with integral bonded laminated polyethylene film, kraft paper moisture barrier underside.

3) Joining - Pittsburgh or modified Pittsburg longitudinal lock seams. 2-inch overlapping circumferential joints with integral locking clips, or butt joints sealed with 2 inch wide mastic backed aluminum snap bands.

4) Fittings - 0.016-inch thick die-shaped fitting covers with factory attached protective liner.

b. Roll Jacketing - Smooth outer finish with integral bonded laminated polyethylene film - kraft paper moisture barrier underside.

c. Sheet Jacketing - Corrugated 1-1/4 inch x 1/4 inch deep with integral bonded laminated polyethylene film - kraft paper moisture barrier underside.

d. Fastening Devices

1) Metal Jacket Bands - 1/2-inch wide; 0.020 inch thick Type 18-8 stainless steel.

2) Wing Seals - Type 18-8 stainless steel, 0.032-inch thick.

3) Sheet Metal Screws - Pan-head Type A hardened aluminum, or stainless steel.

2. Circumferentially Corrugated Aluminum Jacketing - Childer's Corrolon.

a. Construction - 3/16 inch circumferentially corrugated embossed aluminum, ASTM B 209, Type 1100, 3003, 3105, or 5005, Temper H14.

b. Thickness - 0.016 inch.

c. Moisture Barrier - Integrally bonded to jacket over entire surface in contact with insulation.

d. Fastening Devices

1) Strapping - 0.020-inch thick by 1/2-inch wide, Type 3003, 3105, or 5005 aluminum. Temper H14.

2) Wing Seals - 0.032 inch thick Type 5005 aluminum. Temper H14.

2.03. ADHESIVES, MASTICS, AND SEALERS

A. Lagging Adhesive (Canvas Jackets) - Childer's CP-50A, Epolux's Cadalag 336, Foster's 30-36.

B. Vapor Seal Adhesive (Fibrous Glass Insulation) - Childers' CP-82, Epolux's Cadoprene 400, Foster's 85-75 or 85-20.

C. Vapor Barrier Mastic/Joint Sealer (Fibrous Glass Insulation) - Childers' CP-30, Epolux's Cadalar 670, Foster's 95-44 or 30-35.

D. Adhesive (Flexible Elastomeric Foam) - Armstrong's 520, Childers' CP-80, Epolux's Cadoprene 488, Foster's 82-40.

E. Adhesive (Reinforcing Membrane) - Childers' Chil-Spray WB CP-56.

F. Mastic (Reinforcing Membrane) - Childers' AK-CRYL CP-9.

G. Sealant (Metal Pipe Jacket) - One-part silicone sealant for high temperatures; Dow Corning's Silastic 736 RTV or General Electric's RTV 106.

2.04. MISCELLANEOUS MATERIALS

A. Insulation Fasteners

1. Acceptable Manufacturers - Duro-Dyne Corp.; Erico Fastening Systems, Inc.

2. Type - Weld pins, complete with self-locking insulation retaining washers.

B. Pressure Sensitive Tape for Sealing Laminated Jackets

1. Acceptable Manufacturers - Alpha Associates, Childers, Ideal Tape, Morgan Adhesive.

2. Type - Same construction as jacket.

C. Wire, Bands, and Wire Mesh

1. Binding and Lacing Wire - Nickel copper alloy or copper clad steel.

2. Bands - Galvanized steel, 1/2-inch wide x 0.015-inch thick, with 0.032 inch thick galvanized wing seals.

3. Wire Mesh - Woven 20 gage steel wire with 1-inch hexagonal openings, galvanized after weaving.

D. Reinforcing Membrane - Glass or Polyester, 10 x 10 mesh. Alpha Associates Style 59, Childers Chil-Glas, Foster's MAST-A-FAB.

PART 3 EXECUTION

3.01. PREPARATION

A. Perform the following prior to starting insulation work:

1. Install all hangers, supports, and appurtenances in their permanent locations.

2. Complete testing of piping.

3. Clean and dry all surfaces to be insulated.

3.02. INSTALLATION, GENERAL

A. Install the work of this section in accordance with manufacturer's printed installation instructions unless otherwise specified.

B. Provide continuous piping insulation and jacketing when passing thru interior wall, floor, and ceiling construction.

1. At Through Penetration Firestops - Coordinate insulation densities with the requirements of approved firestop system being installed. See Section 15401, Plumbing Firestopping.

a. Insulation densities required by approved firestop system may vary with the densities specified in this section. When this occurs, use the higher density insulation.

C. Individual piping runs shall have consistent insulation type.

D. Apply Insulation to completely cover entire surface of piping. Do not insulate over weld certification stamps.

E. Piping being installed exposed to interior space shall be installed with a PVC jacketing.

3.03. INSTALLATION AT HANGERS AND SUPPORTS

A. Reset and realign hangers and supports if they are displaced during insulation installation.

B. Install high density jacketed insulation inserts at hangers and supports for insulated piping as specified.

1. Insulation Inserts For Use with Fibrous Glass Insulation

a. Where clevis hangers are used, install insulation shields and high density jacketed insulation inserts between shield and pipe.

b. Where insulation is subject to compression at points over 180 degrees apart, e.g. riser clamps, U-bolts, or trapezes, fully encircle pipe with two protection shields and two high density jacketed fibrous glass insulation inserts within supporting members.

1) Exception - Locations where pipe covering protection saddles are specified for hot service piping, 6 inch and larger.

2. Insulation Inserts For Use with Flexible Elastomeric Foam Insulation

a. Where clevis hangers are used, install insulation shields with hardwood filler pieces, same thickness as adjoining insulation, inserted in undersized die cut or slotted holes in insulation at support points.

b. Where hardwood blocks are used, contour to match the curvature of pipe, and shield.

c. Coat dowels and blocks with insulation adhesive, and insert while still wet.

d. Vapor seal outer surfaces of dowels and blocks with adhesive after insertion.

e. Provide minimum two dowels plugs or one filler block per hanger.

3.04. INSTALLATION OF FIBROUS GLASS COLD SERVICE INSULATION

A. Install insulation materials with a field or factory applied ASTM C 1136 Type I laminated vapor barrier jacket, unless otherwise specified.

B. Piping

1. Butt insulation joints together.

2. Continuously seal joints with minimum 1-1/2-inch wide self-sealing longitudinal jacket laps and 3-inch wide butt adhesive backed strips, or 3-inch wide pressure sensitive sealing tape of same material as jacket.

3. Bed insulation in a 2-inch wide band of vapor barrier mastic and vapor seal exposed ends of insulation with vapor barrier mastic at each butt joint between pipe insulation and equipment, fittings, or flanges at the following intervals:

a. Horizontal Pipe Runs - 21 feet.

b. Vertical Pipe Runs - 9 feet.

C. Fittings, Valves, Flanges and Irregular Surfaces

1. Insulate with mitre cut or pre-molded fitting insulation of same material and thickness as adjoining pipe insulation.

2. Secure insulation in place with 16 gage wire, with ends twisted and turned down into insulation.

3. Butt fitting, valve, and flange insulation against pipe insulation and bond with insulating cement.

4. Insulate valves up to and including bonnets, without interfering with packing nuts.

5. Apply leveling coat of insulating cement to smooth out insulation and cover wiring.

6. When insulating cement has dried, seal fitting, valve and flange insulation by embedding a layer of reinforcing membrane of 4 oz. canvas jacket between two flood coats of vapor barrier mastic, each 1/8 inch thick wet.

7. Lap reinforcing membrane or canvas on itself and adjoining pipe insulation at least 2 inches.

8. Trowel, brush, or rubber glove outside coat over entire insulated surface.

D. Fittings, Valves, Flanges and Irregular Surfaces - Alternate

1. Apply one piece pre-molded PVC fitting covers with fibrous glass insulation inserts with galvanized coated tack fasteners. Tape circumferential joint between insulation and premolded fitting cover with 2 inch wide pressure sensitive polyvinyl tape.

a. Exception - Provide additional insulation inserts on service operating at under 45 degrees F or where insulation thickness exceeds 1-1/2 inches. Ensure that insulation is adequate to prevent PVC fitting jacket temperature from falling below 45 degrees F.

3.05. INSTALLATION OF FIBROUS GLASS HOT SERVICE INSULATION

A. Install insulation materials with field or factory applied ASTM C 1136 Type I laminated vapor barrier jacket unless otherwise specified.

B. Canvas Jackets on Piping, Fittings, Valves, Flanges, Unions, and Irregular Surfaces

1. For Piping 2-inch size and Smaller - 4 oz per sq yd unless otherwise specified.

2. For Piping Over 2-inch size - 6 oz per sq yd unless otherwise specified.

C. Piping

1. Butt insulation joints together.

2. Continuously seal joints with minimum 1-1/2-inch wide self-sealing longitudinal jacket laps and 3-inch wide butt adhesive backed strips, or 3-inch wide pressure sensitive sealing tape of same material as jacket.

3. Fill voids in insulation at hanger with insulating cement.

4. Exceptions

a. Piping in Accessible Shafts, Attic Spaces, Crawl Spaces, Unfinished Spaces, and Concealed Piping - Butt insulation joints together and secure with minimum 1-1/2-inch wide longitudinal jacket laps and 3-inch wide butt strips of

same material as jacket, with outward clinching staples on maximum 4-inch centers. Fill voids in insulation at hangers with insulating cement.

b. Piping in Tunnels - Butt insulation joints together and secure with minimum 1-1/2-inch wide longitudinal jacket laps and 3-inch wide butt strips, of same material as jacket, with outward clinching staples on maximum 4-inch centers and 16 gage wires a minimum of four loops per section. Fill voids in insulation with insulating cement.

5. Fittings, Valves, Flanges and Irregular Surfaces

a. Insulate with mitre cut or pre-molded fitting insulation of same material and thickness as adjoining pipe insulation.

b. Secure insulation in place with 16 gage wire, with ends twisted and turned down into insulation.

c. Butt fitting, valve, and flange insulation against pipe insulation and bond with insulating cement.

d. Insulate valves up to and including bonnets, without interfering with packing nuts.

e. Apply leveling coat of insulating cement to smooth out insulation and cover wiring.

f. When insulating cement has dried, coat insulated surface with lagging adhesive, and apply 4 oz. or 6 oz. canvas jacket as required by pipe size.

1) Lap canvas jacket on itself and adjoining pipe insulation at least 2 inches.

2) Size entire canvas jacket with lagging adhesive.

g. Exceptions

1) Insulate fittings, valves, and irregular surfaces 3-inch size and smaller with insulating cement covered with 4- or 6-oz canvas jacket as required by pipe size. Terminate pipe insulation adjacent to flanges and unions with insulating cement, troweled down to pipe on a bevel.

2) Sizing of canvas surface is not required on fittings, valves, flanges, and irregular surfaces in concealed piping, piping in accessible shafts, attic spaces, crawlspaces, unfinished spaces, and tunnels.

6. Fittings, Valves, Flanges and Irregular Surfaces - Alternate

a. Apply one-piece pre-molded PVC fitting covers with fibrous glass insulation inserts with galvanized coated tack fasteners. Tape circumferential joint between insulation and premolded fitting cover with 2-inch wide pressure-sensitive polyvinyl tape.

1) Exception - Provide additional insulation inserts on service operating at over 250 degrees F or where insulation thickness exceeds 1-1/2 inches. Ensure that insulation is adequate to prevent PVC fitting jacket temperature from exceeding 150 degrees F.

3.06. INSTALLATION OF FLEXIBLE ELASTOMERIC FOAM INSULATION

A. Slit insulation and install over pipe. Seal longitudinal and butt joints with adhesive.

B. Insulate fittings and valves with miter cut sections. Use templates provided by the manufacturer and assemble the cut sections in accordance with the manufacturer's printed instructions.

1. Insulate threaded fittings and valves with sleeved fitting covers. Overlap and seal the covers to the adjoining pipe insulation with adhesive.

C. Carefully mate and seal with adhesive all contact surfaces to maintain the integrity of the vapor barrier system.

D. Insulated Covers for Pumps - Do not extend pump insulation beyond or interfere with stuffing boxes, or interfere with adjustment and servicing of parts requiring regular maintenance or operating attention.

E. Piping Exposed to the Elements

1. Apply flexible elastomeric foam insulation to piping with adhesive.

2. Apply reinforcing membrane around piping insulation with adhesive or mastic.

3. Adhesive Applied System - Apply another coat of mastic over reinforcing membrane.

4. Mastic Applied System - Apply another coat of mastic over reinforcing membrane.

3.07. INSTALLATION OF METAL JACKETING ON PIPING

A. Secure jacketing to insulated piping with preformed aluminum snap straps and stainless steel strapping installed with special banding wrench.

B. Jacket exposed insulated fittings, valves and flanges with mitered sections of aluminum jacketing.

1. Seal joints with sealant and secure with preformed aluminum bands.

2. Alternate - Factory fabricated, preformed, sectional aluminum fitting covers may be used in lieu of mitered sections of aluminum jacketing for covering fittings, valves and flanges.

3.08. SCHEDULE OF PIPING INSULATION

A. Insulate all cold service and hot service piping, and appurtenances except where otherwise specified.

B. Plumbing Piping Systems

1. Domestic Hot Water Supply (105 to 140 degrees F)

a. Glass Fiber Insulation

1) Pipe Size Range - Up to 1-1/2 inch.

a) Thickness - 1 inch.

2) Pipe Size Range - Over 1-1/2 inch.

a) Thickness - 2 inch.

2. Tempered Domestic Water Supply

a. Glass Fiber Insulation

1) Pipe Size Range - Up to 1-1/2 inch.

a) Thickness - 1 inch.

2) Pipe Size Range - Over 1-1/2 inch.

a) Thickness - 2 inch.

3. Domestic and non-potable Cold Water:

a. Glass Fiber Insulation

1) Pipe Size Range - All sizes.

a) Thickness - 1/2 inch.

C. Schedule of Items Not to be Insulated

1. Chrome-plated piping, unless otherwise specified.

2. Water heater blowoff piping.

3. Air vents, pressure reducing valves, pilot lines, safety valves, relief valves.

4. Water meters.

5. Sprinkler and standpipe piping, unless otherwise specified.

3.09. SCHEDULE OF INSULATION JACKETING

A. Piping Exterior to Building - Jacket insulated piping with circumferentially corrugated aluminum jacketing.

1. Lap longitudinal and circumferential joints a minimum of 2 inches.

2. Secure jacketing in place with 1/2 inch c 0.020 thick aluminum bands secured with aluminum wing type seals, on maximum 12-inch centers.

3. Cover insulated fittings, valves, and offsets with mitered sections of jacketing. Seal joints with mastic, and secure with aluminum strapping and wing seals.

4. Factory fabricated, preformed fitting covers of same material as jacketing may be used instead of mitered jacketing.

5. Install jacketing to avoid trapping condensation and precipitation.

3.10. PIPING INSULATION SCHEDULE

A. The following insulation and jacket types are referenced in the insulation schedule:

1. Insulation Types

Type	Description
1	Glass Fiber
2	Elastomeric
3	Cellular Glass
4	Mineral Fiber
5	Polyethylene

2. Jacket Types

Type	Description
A	All Service Jacket
B	All Service Jacket with Vapor Barrier
C	PVC Jacket
D	Aluminum Jacket
E	Canvas Jacket

B. Insulation Schedule – Provide insulation types and thickness as indicated in table below.

Piping Systems	Pipe Size (inches)	Insulation Type	Jacket Type	Insulation Thickness
Plumbing				
Tempered Water	All	1	A and C(1)	1” minimum
Potable Water - Cold	3” and Smaller	1	B and C(1)	3/4” minimum
Potable Water - Hot	All	1	A and C(1)	1” minimum
Non Potable Water	3” and Smaller	1	B and C(1)	3/4” minimum
Piping Exposed to Freezing with Heat Tracing	All	1	B and D(2)	1-1/2” minimum

(1) Not required for piping above suspended ceilings and inside pipe chases. In mechanical rooms (i.e., boiler rooms), painted canvas jacket is acceptable.
(2) Insulated exterior piping to have aluminum jacketing.

END OF SECTION

SECTION 15440

PLUMBING FIXTURES

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Water closets (replaced in-kind).

B. Lavatories (replaced in-kind).

1.02. REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. ANSI Z358.1 - American National Standard for Emergency Eyewash and Shower Equipment; 2009.

C. ASME A112.6.1M - Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2002).

D. ASME A112.18.1 - Plumbing Supply Fittings; 2012.

E. ASME A112.19.2 - Ceramic Plumbing Fixtures; 2013.

F. NSF 61 - Drinking Water System Components - Health Effects; 2014 (Errata 2015).

G. NSF 372 - Drinking Water System Components - Lead Content; 2011.

1.03. SUBMITTALS

A. Product Data - Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

B. Maintenance Data - Include fixture trim exploded view and replacement parts lists.

C. Warranty - Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04. QUALITY ASSURANCE

A. Manufacturer Qualifications - Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.05. REGULATORY REQUIREMENTS

A. Products Requiring Electrical Connection - Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.06. WARRANTY

A. See Section 01700, Closeout and Record Documents, for additional warranty requirements.

PART 2 PRODUCTS

2.01. GENERAL

A. Potable Water Systems - Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02. FLUSH VALVE WATER CLOSETS

A. Floor-mounted, vitreous china, siphon jet flush action, bowl with elongated rim, sensor operated flush operation, china bolt caps.

1. Color - White.

2. Manufacturers

a. American Standard, Inc. - www.americanstandard-us.com/#sle.

b. Gerber Plumbing Fixtures LLC - www.gerberonline.com.

c. Kohler Company - www.kohler.com.

d. Zurn Industries, Inc. - www.zurn.com.

e. Approved Equal.

B. Seats

1. Manufacturers

a. American Standard, Inc. - www.americanstandard-us.com/#sle.

b. Bemis Manufacturing Company - www.bemismfg.com.

c. Church Seat Company - www.churchseats.com.

d. Zurn Industries, Inc. - www.zurn.com.

e. Approved Equal.

2. Solid white plastic, open front, extended back, self-sustaining hinge, brass bolts, with cover.

2.03. LAVATORIES

A. Lavatory Manufacturers

1. American Standard, Inc. - www.americanstandard-us.com/#sle.

2. Kohler Company - www.kohler.com.

3. Zurn Industries, Inc. - www.zurn.com.

4. Approved Equal.

B. Vitreous China Wall Mount Sink – ASME A112.19.2; vitreous china wall mount lavatory with front overflow, self-rimming.

1. Drilling Centers - 4-inch (100 mm).

C. Supply Faucet Manufacturers

1. American Standard, Inc. - www.americanstandard-us.com#sle.

2. Sloan

3. Kohler Company - www.kohler.com.

4. Zurn Industries, Inc. - www.zurn.com.

5. Approved Equal.

D. Accessories

1. Chrome-plated 17 gage, 0.0538 inch (1.37 mm) brass P-trap with cleanout plug and arm with escutcheon.

2. Offset waste with perforated open strainer.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Verify that electric power is available and of the correct characteristics.

C. Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.02. PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.03. INSTALLATION

A. Install components level and plumb.

3.04. INTERFACE WITH WORK OF OTHER SECTIONS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.05. ADJUSTING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.06. CLEANING

A. Clean plumbing fixtures and equipment.

3.07. PROTECTION

A. Protect installed products from damage due to subsequent construction operations.

B. Repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 15450

PLUMBING EQUIPMENT

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Water Heaters

1. Electric.

B. Diaphragm-type compression tanks.

1.02. REFERENCE STANDARDS

A. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels; 2015.

B. UL 174 - Standard for Household Electric Storage Tank Water Heaters; Current Edition, Including All Revisions.

C. UL 1453 - Standard for Electric Booster and Commercial Storage Tank Water Heaters; Current Edition, Including All Revisions.

1.03. SUBMITTALS

A. Product Data

1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.

2. Indicate pump type, capacity, power requirements.

3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.

4. Provide electrical characteristics and connection requirements.

1.04. QUALITY ASSURANCE

A. Manufacturer Qualifications - Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Certifications

1. Water Heaters - NSF approved.

2. Electric Water Heaters - UL listed and labeled to UL 174.

3. Products Requiring Electrical Connection - Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

PART 2 PRODUCTS

2.01. WATER HEATERS

A. Manufacturers

1. A.O. Smith Water Products Co - www.hotwater.com.
2. Bock Water Heaters, Inc - www.bockwaterheaters.com.
3. Rheem Manufacturing Company - www.rheem.com.
4. Approved Equal.

B. Electric

1. Type - Automatic, electric, vertical storage.
2. Tank - Glass lined welded steel, thermally insulated with 1-inch (25 mm) thick foam plastic; encased in corrosion-resistant steel jacket; baked-on enamel finish.
3. Accessories
   a. Water Connections - Brass.
   b. Dip Tube - Brass.
   c. Drain valve.
   d. Anode - Aluminum with steel core.
   e. Temperature and Pressure Relief Valve - ASME labeled.

2.02. DIAPHRAGM-TYPE COMPRESSION TANKS

A. Construction - Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psig (860 kPa), with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.

B. Accessories - Pressure gage and air-charging fitting, tank drain; precharge to 12 psig (80 kPa).

PART 3 EXECUTION

3.01. INSTALLATION

A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.

B. Domestic Water Storage Tanks

1. Provide steel pipe support, independent of building structural framing members.
2. Clean and flush prior to delivery to site. Seal until pipe connections are made.

END OF SECTION

SECTION 15530

REFRIGERANT PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Refrigerant Piping and fittings

2. Refrigerants

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Refrigerant Piping and fittings

1. Mueller Industries Inc., Memphis TN

2. Cerro Flow Products LLC, St. Louis, IL

3. Or approved equal.

B. Refrigerant

1. DuPont Fluorochemicals Div., Wilmington, DE

2. Genetron Refrigerants; Honeywell International Inc., Charlotte, NC

3. Mexichem Fluor Inc., St. Gabriel, LA

4. Or approved equal.

2.02 REFRIGERANT PIPING

A. Refrigerant piping shall be copper tube ASTM B 280, Type ACR.

B. Fittings: Wrought-Copper, ASME B16.22

C. Unions: Wrought-Copper, ASME B16.22

D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

E. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.

2. End Connections: Socket ends.

3. Offset Performance: Capable of minimum three-quarter (3/4)-inch misalignment in minimum seven (7) inch-long assembly.

4. Working Pressure Rating: Factory test at minimum five hundred (500) psig.

5. Maximum Operating Temperature: two hundred fifty (250) deg F.

2.03 REFRIGERANT

A. Refrigerant shall be ASHRAE 34, R-410A: Pentafluoroethane/ Difluoromethane.

PART 3 EXECUTION

3.01 INSTALLATION

A. 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 Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. 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.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection.

L. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

M. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.

2. Install horizontal suction lines with a uniform slope downward to compressor.

3. Install traps and double risers to entrain oil in vertical runs.

4. Liquid lines may be installed level.

N. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

O. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

P. Install sleeves for piping penetrations of walls, ceilings, and floors.

Q. Install sleeve seals for piping penetrations of concrete walls and slabs.

R. Pipe Joint Construction

1. Ream ends of pipes and tubes and remove burrs.

2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

3. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

S. Hangers and Supports

1. Install the following pipe attachments:

a. Adjustable steel clevis hangers for individual horizontal runs less than twenty (20) feet long.

b. Roller hangers and spring hangers for individual horizontal runs twenty (20) feet or longer.

c. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping twenty (20) feet or longer, supported on a trapeze.

d. Spring hangers to support vertical runs.

e. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

2. Install hangers for copper tubing with the following maximum spacing and minimum rod diameters:

a. NPS 1/2: Maximum span, sixty (60) inches (fifteen hundred [1500] mm); minimum rod, one-quarter (1/4) inch.

b. NPS 5/8: Maximum span, sixty (60) inches (fifteen hundred [1500] mm); minimum rod, one-quarter (1/4) inch.

c. NPS 1: Maximum span, seventy-two (72) inches (eighteen hundred [1800] mm); minimum rod, one-quarter (1/4) inch.

d. NPS 1-1/4: Maximum span, ninety-six (96) inches (twenty-four hundred [2400] mm); minimum rod, three-eights (3/8) inch.

e. NPS 1-1/2: Maximum span, ninety-six (96) inches (twenty-four hundred [2400] mm); minimum rod, three-eights (3/8) inch.

f. NPS 2: Maximum span, ninety-six (96) inches (twenty-four hundred [2400] mm); minimum rod, three-eights (3/8) inch.

3. Support multifloor vertical runs at least at each floor.

T. Perform the following tests and inspections:

1. Comply with ASME B31.5, Chapter VI.

2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.

3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.

a. Fill system with nitrogen to the required test pressure.

b. System shall maintain test pressure at the manifold gage throughout duration of test.

c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.

d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

4. Prepare test and inspection reports.

U. System Charging

1. Charge system using the following procedures:

a. Install core in filter dryers after leak test but before evacuation.

b. Evacuate entire refrigerant system with a vacuum pump to five hundred (500) micrometers. If vacuum holds for twelve (12) hours, system is ready for charging.

c. Break vacuum with refrigerant gas, allowing pressure to build up to two (2) psig.

d. Charge system with a new filter-dryer core in charging line.

3.02 ADJUSTING / PROTECTION / CLEANUP

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.

2. Verify that compressor oil level is correct.

3. Open compressor suction and discharge valves.

4. Open refrigerant valves except bypass valves that are used for other purposes.

5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION

SECTION 15761

ELECTRIC UNIT HEATERS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes wall and ceiling heaters with propeller fans and electric-resistance heating coils.

1. Electric Unit Heaters

2. Explosion Proof Electric Unit Heaters

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.

2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Include details of anchorages and attachments to structure and to supported equipment.

4. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.

5. Wiring Diagrams: Power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

1.03 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Electric Unit Heaters:

1. Chromalox, Inc.

2. INDEECO.

3. QMark; Marley Engineered Products.

4. Or approved equal

B. Explosion Proof Electric Unit Heaters

1. Chromalox, Inc.

2. INDEECO.

3. QMark; Marley Engineered Products.

4. Or approved equal

2.02 MATERIALS/EQUIPMENT

A. General

1. Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.

2. 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. Electric Unit Heaters

1. Cabinet

a. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners.

b. 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.

c. Surface-Mounted Cabinet Enclosure: Steel with finish to match cabinet.

2. Coil

a. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection.

3. Fan and Motor

a. Fan: Aluminum propeller directly connected to motor.

b. Motor characteristics such as NEMA designation, temperature rating, service factor, enclosure type, and efficiency are specified in Section 15170 - Motors If different characteristics are required, insert paragraphs below to suit Project.

c. Motor: Permanently lubricated, multispeed.

4. Controls

a. Controls: Unit-mounted thermostat.

b. Electrical Connection: Factory wire motors and controls for a single field connection.

C. Explosion Proof Electric Unit Heaters

1. General

a. Fan shall be UL and cUL approved for Class 1, Divisions 1 and 2, Group C and D; Class II, Divisions 1 and 2, Groups E, F, and G.

2. Cabinet

a. Cabinet shall be industrial grade, corrosion resistant 14 gauge steel with a polyester powder coat.

3. Heat Exchanger

a. Heat Exchanger shall be liquid-to-air design, utilizing a steel tube core with integral aluminum fins.

b. Heat transfer fluid shall be nontoxic, inhibited, propylene glycol the provides freeze protection down to -49º F

4. Fan and Moter

a. Fan motor shall be permanently lubricated type with built in thermal overload protection.

5. Controls

a. Unit heater shall be provided with a built-in thermostat and disconnect switch with external handle.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install wall and ceiling unit heaters to comply with NFPA 90A.

B. Install wall and ceiling unit heaters level and plumb.

C. Install wall-mounted 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.

D. Ground equipment according to Section 16060 - Grounding and Bonding

E. Connect wiring according to Section 16123 - Building Wire and Cable.

END OF SECTION

SECTION 15810

DUCTS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Rectangular ducts and fittings.

2. Sheet metal materials.

3. Sealants and gaskets.

4. Hangers and supports.

5. Seismic-restraint devices.

1.02 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. Seismic considerations: The Building Code of the State of New York, latest edition (including amendments) shall be in effect. Submit shop drawings for all duct supports and anchors that include seismic restraint calculations and details as required to meet earthquake design data indicated on structural Drawings. Calculations and details, if required, shall be designed and stamped by a New York registered professional engineer retained by the Contractor. Retain paragraph below to comply with sustainable design schemes that require compliance with ASHRAE 62.1.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ANSI/ASHRAE 62.1.

1.03 ACTION SUBMITTALS

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

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, 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, seismic restraints, and vibration isolation.

1.04 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. Luminaires.

b. Air outlets and inlets.

c. Speakers.

d. Sprinklers.

e. Access panels.

f. Perimeter moldings.

B. Welding certificates.

1.05 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 PRODUCTS

2.01 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."

2.02 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. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

C. Reinforcement Shapes and Plates: Aluminum, shapes, and bars;

D. Tie Rods: Aluminum, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.03 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.

3. Sealant: Modified styrene acrylic.

4. Water resistant.

5. Mold and mildew resistant.

6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.

7. Service: Indoor and outdoor.

8. Service Temperature: Minus 40 to plus 200 deg F.

9. Substrate: Compatible with 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).

11. Sealant 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."

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, 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. 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).

7. Sealant 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."

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.04 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, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Aluminum Ducts: Stainless steel complying with ASTM A 492.

E. 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.

F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

G. Trapeze and Riser Supports:

1. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.05 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Ductmate Industries, Inc.

2. Hilti, Inc.

3. Mason Industries, Inc.

4. Or approved equal

B. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.

C. Restraint Cables: ASTM A 492, stainless-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.

D. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

E. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 EXECUTION

3.01 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. Contractor shall provide erection/coordination drawings for their equipment in conjunction with the general contractor.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install 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, 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.

K. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

3.02 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.

3.03 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 at a minimum 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 and Lower: Seal Class B.

6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: 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 and Lower: Seal Class C.

10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.

11. Conditioned Space, Exhaust Ducts: Seal Class B.

12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.04 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 thick.

4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "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 of each elbow and within 48 inches 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.

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.

3.05 SEISMIC-RESTRAINT-DEVICE INSTALLATION

A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."

B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install cable restraints on ducts that are suspended with vibration isolators.

E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.

F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.

G. Drilling for and Setting Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect 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. Set anchors to manufacturer's recommended torque, using a torque wrench.

5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.06 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 15820 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.07 DUCT CLEANING

A. Clean new 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 15820 "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.

3.08 START UP

A. Air Balance: Comply with requirements in Section 15950 "Testing, Adjusting, and Balancing for HVAC."

3.09 DUCT SCHEDULE

A. Supply Ducts:

1. Ducts Connected to Fans:

a. Pressure Class: Positive 2-inch wg.

b. Minimum SMACNA Seal Class: A.

c. SMACNA Leakage Class for Rectangular: 12.

2. Ducts Connected to Constant-Volume Air-Handling Units:

a. Pressure Class: Positive 2-inch wg.

b. Minimum SMACNA Seal Class: A.

c. SMACNA Leakage Class for Rectangular: 6.

B. Exhaust Ducts:

1. Ducts Connected to Fans:

a. Pressure Class: Negative 1-inch wg.

b. Minimum SMACNA Seal Class: A if negative pressure, and A if positive pressure.

c. SMACNA Leakage Class for Rectangular: 12.

C. Intermediate Reinforcement:

1. Aluminum Ducts: Aluminum.

D. 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 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:

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 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."

E. 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.

END OF SECTION

SECTION 15820

AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.

2. Manual volume dampers.

3. Control dampers.

4. Flange connectors.

5. Turning vanes.

6. Duct-mounted access doors.

7. Flexible connectors.

8. Duct accessory hardware.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.03 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 PRODUCTS

2.01 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.

2.02 MATERIALS

A. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

B. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

C. Reinforcement Shapes and Plates: Aluminum reinforcement where installed on aluminum sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

D. Tie Rods: Aluminum, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.03 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Greenheck Fan Corporation.

2. Ruskin Company.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 1000 fpm.

D. Maximum System Pressure: 2-inch wg.

E. Frame: Hat-shaped, 0.063-inch-thick extruded aluminum, with welded corners or mechanically attached.

F. Blades: Multiple single-piece blades, center pivoted, maximum 6-inch width, 0.050-inch-thick aluminum sheet with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Felt.

I. Blade Axles:

1. Material: Aluminum.

2. Diameter: 0.20 inch.

J. Tie Bars and Brackets: Aluminum.

K. Return Spring: Adjustable tension.

L. Bearings: Steel ball.

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 minimum.

    b. Sleeve Length: 6 inches minimum.

6. Screen Mounting: Rear mounted.

7. Screen Material: Aluminum.

8. Screen Type: Insect.

9. 90-degree stops.

2.04 MANUAL VOLUME DAMPERS

A. Standard, Aluminum, Manual Volume Dampers:

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. Nailor Industries Inc.

    b. Ruskin Company.

2. Standard leakage rating, with linkage outside airstream.

3. Suitable for horizontal or vertical applications.

4. Frames: Hat-shaped, 0.10-inch-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-thick aluminum sheet.

    e. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.

6. Blade Axles: Stainless steel.

7. Bearings:

    a. Stainless-steel sleeve.

    b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Tie Bars and Brackets: Aluminum.

B. Jackshaft:

1. Size: 1-inch diameter.

2. Material: Stainless 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.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut.

2. Include center hole to suit damper operating-rod size.

3. Include elevated platform for insulated duct mounting.

2.05 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, Inc.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Aluminum.

D. Gage and Shape: Match connecting ductwork.

2.06 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, Inc.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of aluminum; 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: Double wall.

2.07 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Aire Technologies.

2. Ductmate Industries, Inc.

3. Or approved equal.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:

a. Double wall, rectangular.

b. Aluminum sheet metal with insulation fill and thickness as indicated for duct pressure class.

c. Vision panel.

d. Hinges and Latches: 1-by-1-inchbutt or piano hinge and cam latches.

e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Aluminum sheet, with bend-over tabs and foam gaskets.

3. Number of Hinges and Locks:

a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.

b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.

c. Access Doors up to 24 by 48 Inches: Continuous and two compression latches.

d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.

C. Pressure Relief Access Door:

1. Door and Frame Material: Aluminum

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.

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-thick, fibrous-glass or polystyrene-foam board.

2.08 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, Inc.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.

D. Fasteners: Aluminum. 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.

F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.09 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ductmate Industries, 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 5-3/4 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, 0.032-inch-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..

2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.

3. Service Temperature: Minus 40 to plus 200 deg F.

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..

2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.

3. Service Temperature: Minus 50 to plus 250 deg F.

2.10 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: 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

3.01 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 aluminum accessories in aluminum ducts.

C. 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 aluminum volume dampers in aluminum ducts where noted.

D. Set dampers to fully open position before testing, adjusting, and balancing.

E. Install test holes at fan inlets and outlets and elsewhere as indicated.

F. 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 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 spacing.

8. Upstream from turning vanes.

9. Upstream or downstream from duct silencers.

10. Control devices requiring inspection.

11. Elsewhere as indicated.

G. Install access doors with swing against duct static pressure.

H. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.

2. Two-Hand Access: 12 by 6 inches.

3. Head and Hand Access: 18 by 10 inches.

4. Head and Shoulders Access: 21 by 14 inches.

5. Body Access: 25 by 14 inches.

6. Body plus Ladder Access: 25 by 17 inches.

I. Label access doors according to Section 15076 “Piping and Equipment Identification” to indicate the purpose of access door.

J. Install flexible connectors to connect ducts to equipment.

K. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.

L. Install duct test holes where required for testing and balancing purposes.

3.02 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 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.

END OF SECTION

SECTION 15830

FANS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: For each product.

1. Roof mounted centrifugal fans.

1.02 ACTION SUBMITTALS

A. Product Data:

1. Include rated capacities, furnished specialties, and accessories for each fan.

2. Certified fan performance curves with system operating conditions indicated.

3. Certified fan sound-power ratings.

4. Motor ratings and electrical characteristics, plus motor and electrical accessories.

5. Material thickness and finishes, including color charts.

6. Dampers, including housings, linkages, and operators.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.

2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Include diagrams for power, signal, and control wiring.

4. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

5. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

1.03 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

B. Field quality-control reports.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For centrifugal fans to include in emergency, operation, and maintenance manuals.

1.05 MAINTENANCE MATERIAL SUBMITTALS

A. Belts: One set(s) for each belt-driven unit.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. AMCA Compliance: Comply with AMCA performance requirements and bear the AMCA-Certified Ratings Seal.

2.02 ROOF MOUNTED CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Greenheck.

2. Aerovent; a division of Twin City Fan Companies, Ltd.

3. Loren Cook Company.

4. Or approved equal

B. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.

2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.

3. Factory-installed and -wired disconnect switch.

C. Housings:

1. Spun aluminum housing utilizing corrosion resistant fasteners. Minimum 11 gauge marine alloy aluminum

2. Formed panels to make curved-scroll housings with shaped cutoff.

3. Panel Bracing: supports for mounting and supporting fan scroll, wheel, motor, and accessories.

4. Horizontally split, bolted-flange housing.

5. Spun inlet cone with flange.

6. Outlet flange.

D. Wheels:

1. Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blades, and fastened to shaft with set screws.

2. Welded or riveted to flange and backplate; cast-iron or cast-steel hub riveted to backplate.

E. Shafts:

1. Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with adjustable alignment and belt tensioning.

2. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.

3. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

F. Grease-Lubricated Shaft Bearings:

1. Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.

G. Belt Drives:

1. Factory mounted, with adjustable alignment and belt tensioning.

2. Service Factor Based on Fan Motor Size: 1.5.

3. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.

4. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.

5. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.

6. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

7. Motor Mount: Adjustable for belt tensioning.

H. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.

2. Scroll Drain Connection: NPS 1 steel pipe coupling welded to low point of fan scroll.

3. Companion Flanges: Rolled flanges for duct connections of same material as housing.

4. Variable Inlet Vanes: With blades supported at both ends with two permanently lubricated bearings of same material as housing. Variable mechanism terminating in single control lever with control shaft for double-width fans.

5. Discharge Dampers: Assembly with opposed blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.

6. Inlet Screens: Grid screen of same material as housing.

7. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.

8. Spark-Resistant Construction: AMCA 99.

9. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.

10. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

2.03 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with 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.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install centrifugal fans level and plumb.

B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

D. Equipment Mounting:

1. Install centrifugal fans on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03300 "Cast-in-Place Concrete."

E. Curb Support: Install roof curb on roof structure, level and secure, according to "The NRCA Roofing and Waterproofing Manual," Low-Slope Membrane Roofing Construction Details Section, Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install and secure centrifugal fans on curbs, and coordinate roof penetrations and flashing with roof construction.

F. Install units with clearances for service and maintenance.

G. Label fans according to requirements specified in Section 15076 "Piping and Equipment Identification."

3.02 CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 15820 "Air Duct Accessories."

B. Install ducts adjacent to fans to allow service and maintenance.

C. Install piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain with pipe sizes matching the drain connection.

3.03 FIELD QUALITY CONTROL

A. Perform the following 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. See Section 15950 "Testing, Adjusting, and Balancing For HVAC" for testing, adjusting, and balancing procedures.

10. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Controls and equipment will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION

SECTION 15850

AIR INLETS AND OUTLETS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Fixed face registers and grilles.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 PRODUCTS

2.01 REGISTERS

A. Fixed Face Register:

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. A-J Manufacturing Co., Inc.

b. Price Industries.

c. Titus, a division of Air System Components; Johnson Controls, Inc.

d. Or approved equal

2. Material: Aluminum.

3. Finish: Baked enamel, white.

4. Face Blade Arrangement: Horizontal spaced 3/4 inch apart.

5. Face Arrangement: Perforated core.

6. Core Construction: Integral.

7. Frame: 1-1/4 inches wide.

8. Mounting Frame: Filter.

9. Mounting: Countersunk screw.

10. Damper Type: Adjustable opposed blade.

11. Accessory: Filter.

2.02 GRILLES

A. Fixed Face Grille:

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. A-J Manufacturing Co., Inc.

b. Price Industries.

c. Titus, a division of Air System Components; Johnson Controls, Inc.

d. Or approved equal

2. Material: Aluminum.

3. Finish: Baked enamel, white.

4. Face Blade Arrangement: Horizontal; spaced 3/4 inch apart.

5. Face Arrangement: Perforated core.

6. Core Construction: Integral.

7. Frame: 1-1/4 inches wide.

8. Mounting Frame: Filter.

9. Mounting: Countersunk screw.

10. Accessory: Filter.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install registers and grilles level and plumb.

B. Outlets and Inlets Locations: 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 registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.02 ADJUSTING

A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 15855

SPLIT SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Air Handler Units

2. Condenser Units

3. HVAC Supervisory Controller

B. Related Requirements:

1. Section 15950 – Testing, Adjusting, and Balancing for HVAC

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Split System Air Conditioners

1. Johnson Controls, Milwaukee, WI

2. Daikin, Waller, TX

3. Mitsubishi, New York, NY

4. Or approved equal

B. DDC Controller for HVAC Systems

1. Johnson Controls – Metasys, Milwaukee, WI

2. Siemens, Buffalo Grove, Il

3. Or approved equal

2.02 AIR HANDLER UNIT

A. Unit cabinet shall be constructed of Powder Painted Steel, certified at 750 hours salt spray test to ASTM B-117 Standards.

B. Unit shall be provided with a slide-out composite drain pan.

C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.

D. Provide with Intellispeed VFD.

E. Filters

1. Air filters shall be rated not less than MERV 7 type filters as defined by ASHRAE standard 52.2P.

2.03 CONDENSER UNIT

A. General

1. Outdoor, rooftop or slab mounted, electrically controlled, cooling unit utilizing a fully hermetic, suction gas cooled, direct drive compressor(s) for cooling duty and nickel chromium elements for heating duty.

2. Factory assembled, single- piece outdoor condenser unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and special features required prior to field start- up.

3. Unit shall use environmentally sound, R-410A refrigerant.

4. Unit shall be installed in accordance with the manufacturer's instructions.

5. Unit must be selected and installed in compliance with local, state, and federal codes.

6. Unit shall be capable of starting and running at one hundred and twenty-five (125)°F ambient outdoor temperature, meeting maximum load criteria of AHRI Standard 210/240 or 340/360 at ± ten percent (10%) voltage.

7. Compressor with standard controls shall be capable of operation down to thirty (30)°F, ambient outdoor temperatures. Optional low ambient kit is available if mechanically cooling at ambient temperatures below thirty (30)°F.

B. Unit Cabinet

1. Unit cabinet shall be constructed of galvanized steel with exterior surfaces coated with a non-chalking, powder paint finish, certified at seven hundred and fifty (750) hour salt spray test per ASTM-B117 standards.

2. Unit cabinet exterior paint shall be: film thickness, (dry) 3.0 MILS minimum, gloss (per ASTM D523, 60°F / 16°C): 80+/-5, Hardness: H- 2H Pencil hardness.

C. Outdoor Coils

1. Standard condenser units shall have aluminum Microchannel coils. Standard heat pumps shall have aluminum plate fins mechanically bonded to seamless internally grooved copper tubes with all joints brazed.

2. Shall be leak tested to one hundred and fifty (150) psig, pressure tested to two hundred and fifty (250) psig, and qualified to CSA C22.2 No. 236-11(UL 1995) 4th edition burst test at one thousand, seven hundred, and seventy-five (1775) psig.

3. Assembled unit shall be pressure tested to four hundred and fifty (450) psig.

4. Shall have a flexible epoxy polymer coating uniformly applied to all coil surface areas without material bridging between fins.

5. Coating process shall ensure complete coil encapsulation of tubes, fins and headers.

6. Color shall be high gloss black with gloss per ASTM D523- 89.

7. Uniform dry film thickness from 0.6 to 1.2 mil on all surface areas including fin edges.

8. Superior hardness characteristics of 2H per ASTM 3363-00 and cross- hatch adhesion of 4B- 5B per ASTM D3359- 97.

9. Impact resistance shall be one hundred and sixty (160) in.- lb. (ASTM D2794- 93).

10. Humidity and water immersion resistance shall be a minimum of one thousand (1000) hours (ASTM D2247- 99 and ASTM D870- 02).

11. Corrosion durability shall be confirmed through testing to exceed six thousand (6000) hours salt spray per ASTM B117- 97.

D. Compressors

1. Unit shall use fully hermetic scroll compressors for each independent refrigeration circuit.

2. Compressors shall be protected from an over- temperature and over- amperage conditions by an internal, motor overload device.

3. Compressor shall be factory mounted on rubber grommets.

4. Compressor motors shall have internal line break thermal, current overload and high pressure differential protection.

E. Condenser Fans and Motors

1. Condenser fan motors:

a. Shall be a totally enclosed motor.

b. Shall use permanently lubricated ball-bearings.

c. Shall have inherent thermal overload protection with an automatic reset feature.

d. Shall use a shaft- up design.

2. Condenser Fans:

a. Shall be a direct- driven propeller type fan.

b. Shall have aluminum blades riveted to corrosion- resistant steel spider brackets and be dynamically balanced.

2.04 HVAC Supervisory Controller

A. The Supervisory Controller shall be a fully user-programmable, supervisory controller. The Supervisory Controller shall monitor the network of equipment controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other Network Engines.

B. The Supervisory Controller shall also be a fully user-programmable, equipment controller that includes a minimum of 28 I/O points.

C. Automation Network – The Supervisory Controller(s) shall reside on the automation network and shall support a subnet system controllers via an integral Control network connection.

D. Automation network temporary cellular connection – The BMS shall be provided with a temporary connection via a “master” control engine whereby the Automation network and connected “slave” engines can be accessed remotely before Owner’s IT network is operational. This project shall include at least one connected control engine.

1. The connected control engine shall be a standard catalog product of the BMS manufacturer. Non-standard or custom applications are not acceptable.

2. This connected control engine shall be panel mounted with a cellular modem, remote antenna and antenna cables, 5 port Ethernet switch, and a power supply with convenience outlet.

3. The “master” control engine shall communicate with a temporary Automation Data Server which can be used to remotely load graphics, generate and load database, program, commission and demonstrate the BMS.

4. A one year cellular contract shall be included within this contract at no additional cost to the Owner. Multiple cellular services shall be made available to choose from to allow for best connection strength at the jobsite. The costs of the remote server shall be included within this contract at no additional cost to the Owner.

E. User Interface – Each Supervisory Controller shall have the ability to deliver a web-based User Interface previously described. All computers connected physically or virtually to the automation network shall have access to the web-based user interface.

F. Processor – The Supervisory Controller(s) shall be microprocessor-based with a minimum word size of 32 bits. The Supervisory Controller shall be a multi-tasking, multi-user, and real-time digital control process. Standard operating systems shall be employed. Supervisory Controller(s) size and capability shall be sufficient to fully meet the requirements of this Specification.

G. Memory – Each Supervisory Controller shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.

H. Secure Boot – The Supervisory Controller shall prevent malicious or unauthorized software applications from loading during the system startup process.

I. Background File Transfer – The Supervisory Controller shall provide the capability to download a new image and database to a network engine while the engine is still running and controlling the building.

J. User Authentication – The Supervisory Controller shall support local user authentication.

K. Password Security – Access to the Supervisory Controllers' embedded user interface shall require a password of 8 to 50 characters including a minimum of one lower case letter, one upper case letter, one number, and one special character. An alarm shall be generated after three unsuccessful attempts within 15 minutes and the user shall be denied access until permission is renewed by a system administrator.

L. Network Security – Communication between the Supervisory Controller and other system networked devices including additional Network Engines, Application and Data Servers, Open Data Servers (BACnet listed OWS), and user interface clients shall be encrypted and support HTTPS with Transport Level Security (TLS) Version 1.2. Self-signed certificates are to be provided with the option of configuring trusted certificates. Engines shall also be equipped to optionally support FIPS 140-2 Federal Government encryption standard.

M. Hardware Real Time Clock – The Supervisory Controller shall include an integrated, hardwarebased, real-time clock, with a supercapacitor to maintain time for a minimum of 72 hours during a power loss. Controllers using a battery to maintain time during a power loss shall not be acceptable.

N. Diagnostics – The Supervisory Controller(s) shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Supervisory Controller(s) shall provide both local and remote annunciation of any detected component failures or repeated failures to establish communication.

O. Power Failure – In the event of the loss of normal power, the Supervisory Controller(s) shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.

1. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.

2. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.

P. Certification – The Supervisory Controller(s) shall meet and be listed to the UL 916 Standard for Energy Management Equipment and be FCC Compliant to CFR47, Part 15, Subpart B, Class A.

Q. Device Integration – The Supervisory Controller(s) shall support integrating and supervising networked devices using the following communication protocols on the device/controller network:

1. The Supervisory Controller(s) shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135 on the controller network.

a. The Supervisory Controller(s) shall support Remote Field Bus integration via a BACnet IP to MS/TP router.

b. The Supervisory Controller(s) shall be tested and BTL listed/certified as a BACnet Building Controller (B-BC).

c. A BACnet Protocol Implementation Conformance Statement shall be provided for the Network Engine(s).

2. The Supervisory Controller shall optionally support integration of networked devices using the following networking protocols:

a. Johnson Controls N2 or third party N2 Open devices.

b. LonTalk

c. MODBUS RTU

d. MODBUS TCP

e. KNX

f. M-Bus

g. OPC UA

R. The Supervisory Controller shall employ a finite state programming to eliminate unnecessary conflicts between control functions at crossover points in their operational sequences. Suppliers using non-state based DDC shall provide separate control strategy diagrams for all controlled functions in their submittals.

S. The Supervisory Controller shall be factory programmed with a continuous adaptive tuning algorithm that senses changes in the physical environment and continually adjusts loop tuning parameters appropriately. Controllers that require manual tuning of loops or perform automatic tuning on command only, shall not be acceptable.

T. The Supervisory Controller shall support the following types of inputs and outputs:

1. Universal Inputs – shall be configured to monitor any of the following for Analog inputs: Voltage Mode, Current Mode, Resistive Mode. For Binary Inputs: Dry Contact Maintained Mode, Pulse Counter Mode

2. Analog Outputs – shall be configured to output either of the following: Voltage Mode, Current Mode

3. Binary Outputs – shall output the following: 24VAC Triac

4. Configurable Outputs – shall be configured to output either of the following: Analog Output Voltage Mode; Binary Output 24 VAC Triac Mode

5. The Supervisory Controller shall have the ability to monitor and control a network of sensors and actuators over a Sensor Actuator (SA) Bus dedicated to the controller. This bus shall be a MS/TP Bus supporting BACnet Standard protocol SSPC-135 supporting no less than 9 devices with a maximum distance of 1,200 Ft. between the Network Control Engine and the furthest connected device.

U. The Supervisory Controller shall provide removable, labeled, screw terminal blocks for 24 VAC power, communication bus and I/O point field wiring.

V. The Supervisory Controller shall include the following multi-color, flashing LEDs to indicate important operating conditions and status.

W. Communications Ports – The Supervisory Controller(s) shall provide the following ports for connecting networkable devices:

1. Two (2) USB ports

2. One (1) RS-485 port

3. Two (2) Ethernet ports

X. The Supervisory Controller shall support up to 4 or 50 supervised devices across all supported integrations.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install split system air conditioners in complete accordance with the manufacturer's printed instructions and the approved shop drawings.

B. The Contractor shall provide interconnecting wiring and conduits.

C. Install units level and plumb.

D. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

E. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 07710 – Manufactured Roof Specialties. Anchor units to supports with removable, cadmium-plated fasteners.

F. Program HVAC controller to operate in a lead/lag configuration:

1. Split units shall operate lead/lag on a weekly basis. The controller shall alternate units weekly on Monday at 10 am.

2. If the unit selected as the lead unit is unavailable for operation due to maintenance, failure, or selection of off position at the unit’s (H-O-A) switch,

3. the standby unit shall become the lead unit. Upon failure of the lead unit, the BAS shall automatically initiate the start-up of the standby unit, and signal an alarm to the BAS.

3.02 ADJUSTING / PROTECTION / CLEANUP

A. Adjusting:

1. Upon completion of the installation, the Contractor shall adjust all split system air conditioners for their intended use.

B. Protection:

1. Split system air conditioners shall be protected as per the requirements of the Contract Documents. The use of split system air conditioners shall not be permitted until permission is given by the Engineer.

a. When permission is given, the Contractor shall operate each split system air conditioner to ensure their performance.

C. Cleaning:

1. In addition to the requirements of the Contract Documents, the Contractor shall thoroughly clean all surfaces of the installed split system air conditioners and remove all debris and waste materials resulting from installation.

D. After completing system installation and testing, adjusting, and balancing, clean filter housings and install new filters.

END OF SECTION

SECTION 15950

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Balancing Air Systems:

a. Constant-volume air systems.

1.02 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 independent entity meeting qualifications to perform TAB work.

F. TDH: Total dynamic head.

1.03 INFORMATIONAL SUBMITTALS

A. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

B. Certified TAB reports.

1.04 QUALITY ASSURANCE

A. TAB Specialists Qualifications: Certified by AABC NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC NEBB or TABB.

2. TAB Technician: Employee of the TAB specialist and certified by AABC NEBB or TABB as a TAB technician.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01 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 installed systems for 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 applicable for intended purpose and 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 equipment performance data including fan curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

2. Calculate system-effect factors to reduce performance ratings of 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.

F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, 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 operating safety interlocks and controls on HVAC equipment.

K. 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.

3.02 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures for balancing the systems.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:

a. Duct systems are complete with terminals installed.

b. Volume, smoke, and fire dampers are open and functional.

c. Clean filters are installed.

d. Fans are operating, free of vibration, and rotating in correct direction.

e. Variable-frequency controllers' startup is complete and safeties are verified.

f. Automatic temperature-control systems are operational.

g. Ceilings are installed.

h. Windows and doors are installed.

i. Suitable access to balancing devices and equipment is provided.

3.03 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" and in this Section.

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, install test ports and duct access doors that comply with requirements in Section 15820 "Air Duct Accessories."

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.

3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

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. Check for proper sealing of air-handling-unit components.

K. Verify that air duct system is sealed as specified in Section 15810 "Ducts."

3.05 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. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.

b. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.

c. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

d. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:

a. Measure static pressure directly at the fan outlet or through the flexible connection.

b. Measure static pressure directly at the fan inlet or through the flexible connection.

c. Measure static pressure across each component that makes up the air-handling system.

d. Report artificial loading of filters at the time static pressures are measured.

3. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

4. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. 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.

5. 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 occurs. Measure amperage in full-cooling, full-heating, economizer, and any other 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.

1. Measure airflow of submain and branch ducts.

2. Adjust submain and branch duct volume dampers for specified airflow.

3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.

2. Measure inlets and outlets airflow.

3. Adjust each inlet and outlet for specified airflow.

4. Re-measure each inlet and outlet after they have been adjusted.

3.06 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: No greater than 10% over designed airflow.

2. Air Outlets and Inlets: Plus or minus 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.07 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.

3. Certify validity and accuracy of field data.

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 specialist.

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 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. Inlet vane settings for variable-air-volume systems.

    g. Settings for supply-air, static-pressure controller.

    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

    1. Quantities of outdoor, supply, return, and exhaust airflows.

    2. Water and steam flow rates.

    3. Duct, outlet, and inlet sizes.

    4. Pipe and valve sizes and locations.

    5. Terminal units.

    6. Balancing stations.

    7. Position of balancing devices.

E. 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, and bore.

i. Center-to-center dimensions of sheave and amount of adjustments in inches.

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, and bore.

f. Center-to-center dimensions of sheave and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.

b. Total system static pressure in inches wg.

c. Fan rpm.

d. Discharge static pressure in inches wg.

e. Filter static-pressure differential in inches wg.

f. Preheat-coil static-pressure differential in inches wg.

g. Cooling-coil static-pressure differential in inches wg.

h. Heating-coil static-pressure differential in inches wg.

i. Outdoor airflow in cfm.

j. Return airflow in cfm.

k. Outdoor-air damper position.

l. Return-air damper position.

m. Vortex damper position.

F. 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, and bore.

h. Center-to-center dimensions of sheave and amount of adjustments in inches.

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, and bore.

f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.

b. Total system static pressure in inches wg.

c. Fan rpm.

d. Discharge static pressure in inches wg.

e. Suction static pressure in inches wg.

G. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System and air-handling-unit number.

b. Location and zone.

c. Traverse air temperature in deg F.

d. Duct static pressure in inches wg.

e. Duct size in inches.

f. Duct area in sq. ft..

g. Indicated airflow rate in cfm.

h. Indicated velocity in fpm.

i. Actual airflow rate in cfm.

j. Actual average velocity in fpm.

k. Barometric pressure in psig.

H. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.

b. Serial number.

c. Application.

d. Dates of use.

e. Dates of calibration.

3.08 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Owner.

B. Owner shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

E. If TAB work fails, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.

2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.

3. If the second verification also fails, design professional may contact AABC Headquarters regarding the AABC National Performance Guaranty.

F. Prepare test and inspection reports.

3.09 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

SECTION 16010

GENERAL ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 WORK INCLUDED

A. The work under this Division and applicable sections of Division 17 shall consist of all labor, materials, equipment and services necessary and required to complete all electrical as shown on the Drawings, as described in the specifications, or as inferable from the Drawings and Specifications. Where the words provide or install are used singularly or in combination, it shall mean to furnish and install complete for fully functioning and operational systems. The work shall include but not necessarily be limited to the following:

1. Temporary electric services and feeders as required for bypass pumping and maintenance of power to other buildings during construction.

2. 480 volt switchboards.

3. Lighting and power panelboards, step down transformers, in accordance with drawings, all as indicated on the drawings.

4. Building mains and feeders in accordance with the drawing.

5. Conduit, wiring, outlet boxes, switches, convenience receptacles, etc. for lighting, branches, and relays.

6. Motor disconnect switches as required by Code and as shown on the drawings.

7. Lighting fixtures and lamps.

8. Standby generator for construction.

9. Temporary light and power.

10. Setting of all sleeves, hanger supports and the like.

11. Motor control centers and variable frequency drives, in accordance with drawings, all as indicated on the drawings.

12. Trenching, excavation and backfill, ductbanks.

13. Cutting and patching for installation of electric work.

14. Testing, adjustments and instructions.

15. All other work shown on the drawings and specified in the bid documents.

16. Provision of a complete and operating system.

17. Provide shop drawings for all work.

1.02 CODES AND STANDARDS

A. All materials furnished and all work installed shall comply, where applicable, with the requirements of the current New York State Building Code, Local Codes and the 2017 National Electrical Code. Whenever reference is made of “National Electrical Code” or “NEC,” it shall mean the 2017 National Electrical Code.

B. Material and work shall comply with other Codes and Standards as may be specified or referenced.

C. Where applicable or specified herein, all material and devices furnished shall meet requirements of Underwriters’ laboratories Inc., shall be U.L. listed and where further applicable, shall bear the U.L. listing mark.

D. The Contractor shall be responsible to obtain all permits and pay all fees in relation to the work.

1.03 POWER SHUTDOWN

A. The Contractor may be permitted power shutdowns during normal working hours of 8 a.m. to 3 p.m. Tuesday through Thursday only. Arrange for connections to existing systems as directed by the Engineer and Owner. See Construction Phasing Schedule.

B. The Contractor will schedule and coordinate shutdowns a minimum of two weeks in advance with the Engineer and Owner. Provide at least three (3) days of generator fuel at any time. Pay for all diesel fuel for all shutdowns.

C. The Contractor shall include the cost of performing work during other than normal work hours at overtime or premium wage rates in the bid price. The Contractor will not receive any separate or additional payment for work during other than normal working hours above lump sum bid work included under this Contract.

D. The requirements of specification section 01500 – Temporary Facilities shall also apply.

1.04 FINAL TEST AND INSPECTION

A. The Contractor shall be required to demonstrate to the satisfaction of the Engineer that all the electrical systems, equipment and devices operate as specified.

B. All existing systems shall first be tested by owner to insure total system functioning. The contractor shall adapt, connect to, or modify systems as required.

C. Provide fire underwriters certificate of inspection from an agency authorized by the local authority having jurisdiction.

D. Final test and inspection shall also be in accordance with the requirements of specification 01660 – Testing and Startup.

1.05 ELECTRICAL TESTING

A. After completion of the work, thoroughly test the entire electrical system, including electrical work required for instrumentation, control and power; adjust electrical system as required. Typed, written test reports shall be provided.

B. Test all electrical circuits to insure circuit continuity, insulation resistance, proper splicing, and proper grounds.

C. System performance test runs are required. Coordinate test runs of electrical systems with test runs of equipment served (ex: mechanical, heating, air conditioning, process systems, plumbing, etc.).

D. Testing Methods

1. Switchboards and Panelboards – Test each with mains disconnected from the feeder, branches connected, branch circuit breakers closed, all fixtures in place and permanently connected.

2. Feeders – Test with the feeders disconnected from panels.

3. Individual Power Circuits – Test each individual power circuit at the panel or motor control center with power equipment connected for proper operation.

4. Transformers (low voltage) – megohmmeter test all transformers in accordance with the manufacturer's recommendations.

5. Lighting and receptacle circuits do not need to be megger tested.

6. Megohmmeter Tests – conduct megohmmeter tests of the insulation resistance of rotating and power distribution feeders down to panelboard feeders. The results will be accepted when the megger shows the insulation resistance to be not less than 50 megohms at 20 degrees C using a 1,000 volt megger. Wait 1 minute between each test for all conductors in the same enclosure and each conductor and ground. Perform megohmmeter testing of all motor power and control wiring after cables are in place and just prior to final terminations. Provide a typed, written report for all megohmmeter tests performed.

1.06 TEMPORARY ELECTRIC LIGHT AND POWER AND GENERATOR

A. The Contractor shall be responsible for furnishing, installing, maintaining, and upon completion removing, a system of temporary light and power for the use of all construction trades. If the Contractor requires the de-energizing of the electric service prior to the power system being installed, then he shall provide a generator sized to accommodate the facility's full load including pumps. Installation of cable, overcurrent devices, ground fault protection, shall be included in the contractor's bid. This shall include all overtime required to complete work between Tuesday and Thursday.

B. The requirements of specification section 01500 – Temporary Facilities and 01540 Temporary Bypass Pumping shall also apply.

1.07 CUTTING AND PATCHING

A. The Contractor shall provide all necessary cutting of the walls, floors, ceilings, etc. for installation of conduit, outlet boxes, etc. Cutting shall be kept to a minimum, all areas shall be spray painted for approval prior to any cutting.

B. All finished patching and painting to be by this Contractor. The Contractor shall completely fill all openings left by the removal of conduit, equipment, etc., with regard to floor openings, plywood shall be attached to the underside of the slab to facilitate the filling of the opening completely.

1.08 FIREPROOFING

A. All openings through fireproof barriers and walls shall be fully resealed to maintain the fire rating with 3M CP25WB caulking or approved equal.

B. Fire rated barrier and non-flammable supports for floor openings to be KBS Sealbags or equal.

1.09 HEAT SCAN

A. Upon completion of all work under the contract, the Contractor shall perform a heat scan survey of all his work.

B. Scan shall be performed while the facility is under full operation, and equipment at full load.

C. Equipment shall be capable of taking pictures of all areas, especially problem locations.

D. Results shall be neatly assembled and labeled in three (3) binders for the Owner after the Engineer's approval.

1.10 PERFORMANCE REQUIREMENTS

A. The electrical contractor shall verify that all terminations on contract equipment is proper. Testing for phase rotation, continuity and full operation of the equipment shall be performed.

B. The electrical contractor shall render full assistance to all trades for control wiring sequence and unit operation testing.

1.11 ROOF PENETRATIONS

A. No conduit penetrations shall be made through roofs without prior permission of the Owner.

B. Any penetrations allowed will be performed using pitch pockets as approved by the Owner and Engineer. Existing roof warranty shall be maintained, retain the services of roofing manufacturer for any new roof penetrations.

C. See Specification Section 07530 – EPDM Membrane Roofing for additional requirements and coordination.

1.12 WALL PENETRATIONS

A. All wall penetrations for conduit shall be performed using pre-manufactured wall sleeves as manufactured by Link Seal, OZ Gedney or equal.

1.13 TORQUE REQUIREMENTS

A. All equipment and cable connections shall be tightened to the torque values determined by the manufacturer.

B. Assemble all information after the work is complete in a binder for the owner.

1.14 WORKMANSHIP

A. The Contractor shall perform all operations necessary for the proper installation and operation of all systems.

B. All work performed shall be first class work in every respect. The work shall be performed by mechanics skilled in their respective trades, who shall at all times be under the supervision of competent persons.

C. Work that is slipshod, poorly laid out, not perfectly aligned, or that is not consistent with the requirements generally accepted in the trade for “first class work” will not be acceptable.

D. In addition to the materials specified elsewhere, all other miscellaneous items be necessary for the completion of the work shall be furnished and installed by the Contractor to the extent that all system be complete and operative.

E. Contractor shall submit references for the foreman to run the project. Electrical Foreman shall have a minimum of five (5) years’ experience as a working foreman.

1.15 REGULATIONS AND CERTIFICATES

A. All work required by the Drawings and Specifications shall be installed to comply with all applicable building laws, regulations and ordinances of the State of New York, and local laws and regulations as may apply, except where these requirements are exceeded by the Drawings and Specifications in quality or quantity.

B. Any and all changes in the arrangement of the work, either before or after installation, to suit conditions in the building or the work of other trades, and any and all changes required by agencies having jurisdiction shall be made without extra charge, unless the charges are in consequence of changes made by the Owner.

1.16 OPENINGS

A. The admittance into the building of all equipment and materials furnished under this Contract shall be through finished openings. The Contractor shall refer to the Owner for specific requirements relative to the use of other existing facilities.

1.17 TRENCHING, EXCAVATION, BACKFILL & CONCRETE

A. Contractor shall perform the required trench, excavation, backfill, restoration to original conditions and concrete as indicated on the Drawings and as specified herein. Concrete shall be as specified in Section 03300 – Cast In Place Concrete, dyed red.

1.18 EXPEDITING THE WORK

A. The Contractor shall take all measurements at the job, verify all figured dimensions indicated on the construction drawings, familiarize himself to assure complete knowledge of code requirements and coordinate the work with other trades so as to cause no delay in the work and to eliminate wherever possible future cutting and patching. Any discrepancies or interference shall be reported immediately to the Owner.

1.19 PROTECTION OF THE WORK

A. The Contractor shall provide temporary covering and do all work required to protect work, materials, machinery and equipment from all damage from moisture.

B. After the work is completed, the Contractor shall clean all equipment and piping.

1.20 OPERATING AND MAINTENANCE INSTRUCTIONS

A. The Contractor shall furnish to the Owner and Engineer one set for initial review and a final written operating, maintenance and lubrication instructions for all installed systems and equipment. Instructions shall include copies of all designated approved shop drawings, manufacturer's descriptive data, control diagrams, wiring diagrams, performance test data, test and balance reports and installation and operating instructions as specified.

B. Operation and Maintenance Submittal shall be in accordance with specification section 01700 – Closeout and Record Documents.

C. The Owner's designated operating personnel shall be instructed in the proper operation and maintenance of the equipment as well as the operation and maintenance of the controls for the various systems by the vendor's representative. Informal or unwitnessed instructions, or instructions to non-designated personnel will not be acceptable. In addition to the instruction periods specified elsewhere, the Contractor shall furnish instruction for a minimum of two (2) working day straight time not necessarily consecutive. Prior arrangements for instruction periods shall be made with the Owner.

D. Final payment will not be granted until all manuals and training have been provided to the Owner/Owner's representative.

1.21 RECORD DRAWINGS

A. The Contractor shall maintain an accurate record set of reproducible as-built drawings of any deviations in work as actually installed from the work as indicated on the design drawings. The Contractor shall utilize the contract design drawings for marking up any deviations to the drawings. The record shall be kept current and available at the site for inspection.

B. As-built drawings shall be updated at the site as work progresses.

C. Final payment will not be granted until all final as-built drawings are delivered to the Owner/Owner's Representative.

D. Contractor shall furnish as-built drawings to Engineer 100% of project completion. As-builts are to be submitted in AutoCAD computer format.

E. Record drawings shall be provided in accordance with section 01700 – Closeout and Record Documents.

1.22 GUARANTEE

A. The Contractor shall guarantee clean power throughout the new systems.

B. The Contractor shall guarantee that the capacity of all new equipment installed meets Specification requirements.

C. The Contractor shall guarantee that all new systems will operate without excessive noise and vibration.

D. The Contractor shall obtain from the various manufacturers or vendors standard guarantees or warranties for their particular equipment or components for a period of at least one year, and deliver them to the Owner.

1.23 EQUIPMENT GROUNDING

A. All equipment, panels and devices (except motors) which require electrical connections shall be furnished with a factory-welded (prior to finish painting) ground lug in a concealed and accessible location.

1.24 FINAL INSPECTION

A. The Contractor shall conduct a final inspection of all work installed under each Section of the Specification after the installation have been completed; the testing hereinafter specified has been performed; and test reports have been submitted.

B. During the conduct of the final inspection, the Contractor shall have present a representative of the various manufacturers and a representative of the manufacturers of other pertinent equipment as direct by the Owner.

C. The Contractor shall include in his bid a testing period of two (2) working days wherein all aspects of the electrical systems specified herein will be tested in accordance with detailed test procedures which will be issued by the Owner at a later date. The Contractor shall provide sufficient technical personnel and instruments to perform the tests as directed by the Owner and Engineer. Personnel for each working day shall include one journeyman electrician, one helper, manufacturer's representative as required. The testing period specified herein is in addition to all other testing or instruction periods included in the specifications.

D. The Contractor shall demonstrate, to the satisfaction of the Owner and Engineer, that the systems installed meet Specification requirements and that the capacities and performances of the equipment meets schedule requirements. The contractor shall make all changes, modifications and adjustments to the installed systems, as directed by the Owner, to meet Specifications requirements, at no additional cost to the Owner.

E. The electrical installation shall be inspected by a third party, as required, acceptable to the Owner and the local authority having jurisdiction.

1.25 ALTERATION AND REMOVAL OF EXISTING WORK

A. The Contractor shall refer to the Contract Documents, for specific requirements relative to the existing facilities and the Sequence of work.

B. All existing systems shall be maintained in operation during the construction period as directed by the Owner. Existing systems shall not be shut down nor shall connections be made thereto without prior approval of the Owner.

C. The Contractor shall relocate all existing conduit hangers and supports, as required to accommodate the new installation at no additional costs to the Owner. This includes all work in spaces where new work is specified under this Contract.

D. Unless otherwise specified or indicated on the Drawings, all equipment, piping, appurtenances, etc. are indicated to be removed from the site when directed by the Owner.

1.26 SHOP DRAWINGS

A. The Contractor shall submit copies of manufacturer's shop drawings and descriptive literature together with the manufacturer's installation, operating and maintenance instructions, for all equipment to be incorporated in the work including all required wiring diagrams and shall obtain approval before proceeding with the installation.

B. The Contractor shall submit copies of shop drawings at ¼ inch scale or larger showing all conduit mains, including connections to equipment, and all equipment layouts and shall obtain approval before proceeding with the work. Shop drawings shall be accurately dimensioned so that conduit clears all structural members and other work incorporated in the project. The Contractor shall take all shop drawing measurements at the building.

C. The Contractor shall submit the following shop drawings, manufacturer's brochures, manufacturer's installation and operating instructions, etc. for approval before proceeding with the work:

1. Wire
2. Raceways
3. Wiring Devices
4. Lighting Fixtures
5. Dry Transformers
6. Disconnects
7. Mechanical sleeve seals
8. Electrical supports
9. Grounding and bonding
10. Electrical Identification materials
11. Panelboards
12. 480 Volt Switchboards
13. Motor Control Centers
14. Variable Frequency Drives

D. Acceptance of shop drawings does not absolve the Contractor to provide specified materials and function in the intended manner.

1.27 SHOP DRAWING SUBMISSION

A. All shop drawings submitted shall be in electronic PDF format and identified by transmittal.

B. The transmittal shall have all appropriate information including, project name, date, specification section, submission number, and item description. It is recommended that the attached transmittal form be used to expedient turn over.

C. If this format is not followed, the Engineer reserves the right to reject any submission.

D. Submittals shall be as per the requirements of specification section 01300 – Submittals.

END OF SECTION

SECTION 16015

SHORT-CIRCUIT, COORDINATION AND ARC-FLASH ANALYSIS

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.

1.02. SUMMARY

A. Section includes a preliminary and a final computer-based, short-circuit, coordination and arc-flash studies to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

B. Study shall be performed to include new power distribution equipment and existing power distribution equipment designated to remain. Study shall include all electrical distribution and control equipment, new and existing to remain, included in the contract documents.

C. The project shall begin at the point of service for the Union Hill and Tallman Pump Stations, through the Motor Control Center and continue down through the system, to all downstream 480 volt and 208 volt distribution and branch circuit panelboards, motor control centers, variable frequency drives and significant motor locations/local disconnects.

D. The final study shall be provided after the installation of the power distribution system is complete.

E. The Contractor shall obtain the short circuit current available from the Utility Company, Orange & Rockland.

1.03. DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

C. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

D. SCCR: Short-circuit current rating.

E. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

1.04. SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following submittals after the approval of system protective devices submittals.

1. Study input data, including completed computer program input data sheets.

2. The short-circuit, protective device coordination and arc-flash studies shall be submitted to the Engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the Engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory. Generally, shop drawing submittals for equipment effected by the coordination study will not be reviewed until the short-circuit/coordination study has been submitted and successfully reviewed.

3. The results of the short-circuit, protective device coordination, and arc-flash hazard analysis studies shall be summarized in a final report. Submit bound copies of the final report with tabbed sections, in the quantities required. Additional copies, where required, shall be provided on CD in PDF format.

4. Arc-flash study report; signed, dated, and sealed by a qualified Professional Engineer registered in the state of New York.

    a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

5. The report shall include, but not be limited to, the following sections:

    a. One-line diagram showing protective device ampere ratings and associated designations, cable size & lengths, transformer kVA and voltage ratings, motor and generator kVA ratings, switchboard and panelboard designations.

    b. Descriptions, purpose, basis and scope of the study.

    c. Tabulations of the worst-case calculated short circuit duties as a percentage of the applied device rating (automatic transfer switches, circuit breakers, fuses, etc.); the short circuit duties shall be upward adjusted for X/R ratios that are above the device design ratings.

    d. Protective device time versus current coordination curves with associated one line diagram identifying the plotted devices, tabulations of ANSI protective relay functions and adjustable circuit breaker trip unit settings.

    e. Fault study input data, case descriptions, and current calculations including a definition of terms and guide for interpretation of the computer printout.

    f. Details of the incident energy and flash protection boundary calculations.

    g. Sample of an arc-flash hazard warning label.

h. Comments and recommendations for system improvements, where needed, including extending of feeder or other conductors necessary to lower the fault-current to an acceptable level.

i. Executive summary.

1.05. CLOSEOUT SUBMITTALS

A. Maintenance procedures according to requirements in NFPA 70E shall be provided in the equipment manuals.

B. Operation and Maintenance Procedures: provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.06. QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Arc-Flash Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Arc-Flash Study Specialist Qualifications: Professional Engineer in charge of performing the study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

D. Field Adjusting Agency Qualifications: An independent agency, with the experience and capability to adjust overcurrent devices and to conduct the testing indicated, that is a member company of the National Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to Authorities Having Jurisdiction.

PART 2 PRODUCTS

2.01. COMPUTER SOFTWARE DEVELOPERS

A. Software Developers: Subject to compliance with requirements, available software developers offering software that may be used for the Work include, but are not limited to, the following:

1. ESA Inc.

2. SKM Systems Analysis, Inc.

3. Or approved equal.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.02. DATA COLLECTION

A. Contractor shall furnish all field data as required by the power system studies and arc-flash hazard analysis. The Study Preparer shall furnish the Contractor with a listing of required data. The Contractor shall expedite collection of the data to eliminate unnecessary delays and assure completion of the studies as required for final approval of the distribution equipment.

B. Source contribution may include present and future utility supply, motors, and generators.

C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner or Contractor.

D. Include fault contribution of existing motors in the study, with motors < 25 hp grouped together. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.03. SHORT-CIRCUIT ANALYSIS WITH PROTECTIVE DEVICE EVALUATION

A. Systematically calculate fault currents based on the available fault current at the facility service entrance. Study preparer shall obtain the available fault current from the local utility.

B. Short-circuit calculations shall be prepared by means of a digital computer utilizing a commercially available software package. Motor contribution shall be incorporated in determining fault levels. Results of short-circuit calculations shall be presented in tabular form and shall include momentary and interrupting fault values for three-phase and phase-to-ground faults.

C. Analyze the short-circuit currents by preparing a tabulation comparing the fault levels to the device interrupting ratings. Indicate areas in which integrated/series ratings are utilized. The following information shall be included in the tabulation:

1. Bus identification number.

2. Location identification.

3. Voltage.

4. Manufacturer and type of equipment.

5. Device rating.

6. Calculated short-circuit current.

2.04. PROTECTIVE DEVICE COORDINATION STUDY

A. Prepare coordination time-current characteristic curves to determine the required settings/sizes of the protective devices to maximize selectivity. The utility upstream protective device feeding the facility shall be maintained as the upper limit for coordination. These settings shall be obtained by the preparer, along with any other protective device setting requirements. The coordination curves shall be prepared on log-log paper and illustrate adequate clearing times between series devices. The curves shall be created through the use of the study software package, but must reflect actual protective devices to be installed. Adequate time-current curves shall be generated to depict coordination. In addition, protective device characteristics shall be suitably determined to reflect calculated short-circuit levels at the location.

B. A narrative analysis shall accompany each coordination curve sheet and describe the coordination and protection in explicit detail. All curve sheets shall be multi-color for improved clarity. Areas lacking complete coordination shall be highlighted and reasons provided for allowing condition to remain or provide solution to resolve situation. The following information shall be provided on all curve sheets:

1. Device identification and associated settings/size.

2. Voltage at which curves are plotted.

3. Current multiplier.

4. ANSI frequent fault damage curve.

5. Cable insulation damage curves.

6. Transformer inrush point.

7. Single-line for the portion of the system.

8. Motor starting profiles (where applicable).

2.05. ARC-FLASH HAZARD ANALYSIS

A. The Arc-Flash Hazard Analysis shall be performed by a computer aided circuit simulation of the distribution system specific to this project. These calculations shall determine the Arc-Flash Incident Energy (AFIE) levels and flash protection boundary distances. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, panelboards, busway, generators, automatic transfer switches, and motor-control centers) where work could be performed on energized parts.

B. The Arc-Flash Hazard Analysis shall be performed in conjunction with the Short-Circuit/Coordination Study.

C. Results of the analysis shall be submitted in tabular form and shall include as a minimum the bus name, bolted fault current and arcing fault current level, flash protection boundary distances, personal protective equipment (PPE) hazard risk category and the AFIE levels.

D. The analysis shall be performed under worst-case Arc-Flash conditions, and the final report shall describe the worst-case conditions when different from worst-case bolted fault conditions.

2.06. ARC-FLASH WARNING LABELS

A. Produce a 3.5-by-5-inch thermal transfer label of high-adhesion polyester for each work location included in the analysis.

B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1. Location designation.

2. Nominal voltage.

3. Flash protection boundary.

4. Hazard risk category.

5. Incident energy.

6. Working distance.

7. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

2.07. SINGLE-LINE DIAGRAM

A. The final report shall include a multi-color single-line diagram of the electrical distribution system within the scope of the project. The single-line shall include:

1. Transformer rating, voltage ratio, impedance, and winding connection.

2. Feeder cable phase, neutral and ground sizes, length of cable, conductor material, and conduit size and type.

3. Switchgear, switchboards, panelboards, MCC’s, fuses, circuit breakers, ATS’s and switches continuous current ratings.

4. Protective relays with appropriate device numbers and CT’s and PT’s with associated ratios.

5. Detailed legend indicating device type identification and other significant details.

PART 3 EXECUTION

3.01. SUMMARY

A. The results of the system studies shall be summarized in a final report. One “as-built” copy shall be posted in each main electric or MCC room.

3.02. FIELD SETTINGS/ADJUSTMENTS

A. This Contractor shall engage the equipment manufacturer's service group or alternately a qualified independent testing firm to perform field adjustments of the protective devices as required for placing the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study and protective device evaluation/coordination study.

B. Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with the approved short-circuit and protective device coordination study, shall be carried out by the equipment manufacturer's service group or qualified independent testing firm.

C. Notify Engineer in writing of any required major equipment modifications.

D. Additions, deletions, upgrades or major modifications to any part of the electrical distribution system will require re-calculation of the studies and analysis' for the portions of the system that has been changed from the original studies. These re-calculations shall be completed by the same engineer or firm that did the original studies, at no additional cost to the Owner.

3.03. ARC-FLASH WARNING LABELS

A. Apply arc-flash warning labels to equipment. The labels shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

3.04. ARC-FLASH TRAINING

A. The Contractor of the Arc-Flash Hazard Analysis shall train the Owner's qualified electrical personnel of the potential arc-flash hazards associated with working on energized equipment (minimum of 4 hours). The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET) or equivalent.

END OF SECTION

SECTION 16060

GROUNDING AND BONDING

PART 1 GENERAL

1.01. WORK INCLUDED

A. Section Includes:

1. Rod electrodes.

2. Wire.

3. Mechanical connectors.

4. Exothermic connections.

1.02. REFERENCES

A. Institute of Electrical and Electronics Engineers:

1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.

2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.

1.03. SYSTEM DESCRIPTION

A. Grounding systems use the following elements as grounding electrodes:

1. Metal underground water pipe.

2. Ground ring as indicated on the drawings.

3. Rod electrode.

1.04. DESIGN REQUIREMENTS

A. Construct and test grounding systems for access flooring systems on conductive floors accordance with IEEE 1100.

1.05. PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 5 ohms maximum at 20-feet.

1.06. SUBMITTALS

A. Product Data: Submit data on grounding electrodes and connections.

B. Test Reports: Indicate overall resistance to ground.

C. Manufacturer's Installation Instructions: Submit for active electrodes.

D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.07. CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of components and grounding electrodes.

1.08. QUALITY ASSURANCE

A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.

B. Perform Work in accordance with State of New York standards.

C. Maintain one copy of each document on site.

1.09. QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum three years documented experience.

1.10. PRE-INSTALLATION MEETINGS

A. Convene minimum one week prior to commencing work of this section.

1.11. DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

C. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.12. COORDINATION

A. Complete grounding and bonding of building reinforcing steel prior to concrete placement.

PART 2 PRODUCTS

2.01. ROD ELECTRODES

A. Manufacturers:

1. Apache Grounding/Erico Inc.
2. Copperweld, Inc.
3. Erico, Inc.
4. O-Z Gedney Co.
5. Thomas & Betts.

B. Product Description:

1. Material: Copper-clad steel.
2. Diameter: 5/8" inch.
3. Length: 10 feet.

C. Connector: Connector for exothermic welded connection.

2.02. WIRE

A. Material: Stranded copper.

B. Foundation Electrodes: #2/0 AWG, Ground Grid #4/0 AWG bare.

C. Grounding Electrode Conductor: Copper conductor bare, size to meet NFPA 70 requirements or as shown on the drawings, whichever is greater.

D. Bonding Conductor: Copper conductor bare.

2.03. MECHANICAL CONNECTORS

A. Manufacturers:

1. Apache Grounding/Erico Inc.
2. Copperweld, Inc.
3. Erico, Inc.
4. ILSCO Corporation.
5. O-Z Gedney Co.
6. Thomas & Betts, Electrical.

B. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

2.04. EXOTHERMIC CONNECTIONS

A. Manufacturers:

1. Cadweld.

2. Erico, Inc.

B. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify final backfill and compaction has been completed before driving rod electrodes.

3.02. PREPARATION

A. Remove paint, rust, mill oils, surface contaminants at connection points.

3.03. EXISTING WORK

A. Modify existing grounding system to maintain continuity to accommodate renovations.

B. Extend existing grounding system using materials and methods compatible with existing electrical installations, or as specified.

3.04. INSTALLATION

A. Install in accordance with IEEE 142, 1100.

B. Install rod electrodes at locations as indicated on Drawings. Install additional rod electrodes to achieve specified resistance to ground.

C. Install grounding and bonding conductors concealed from view.

D. Install grounding electrode conductor and connect to reinforcing steel in foundation footing as indicated on Drawings. Electrically bond steel together.

E. Bond together metal structures not attached to grounded structure; bond to ground.

F. Equipment Grounding Conductor: Install separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

G. Install continuous grounding using underground cold water system and building steel as grounding electrode. Where water piping is not available, install artificial station ground by means of driven rods or buried electrodes.

H. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panelboards, transformers switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.

I. Accomplish grounding of electrical system by using insulated grounding conductor installed with feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards with installed number 12 conductor to grounding bus.

J. Grounding electrical system using continuous metal raceway system enclosing circuit conductors in accordance with NEC.

K. Permanently attach equipment and grounding conductors prior to energizing equipment.

3.05. FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.

C. Perform ground resistance testing in accordance with IEEE 142.

D. Perform leakage current tests in accordance with NFPA 99.

E. Perform continuity testing in accordance with IEEE 142, using the fall-of-potential method and provide written report to the Engineer of the results.

F. When improper grounding is found on receptacles, check receptacles in entire project and correct. Perform retest.

END OF SECTION

SECTION 16070

ELECTRICAL HANGERS, SUPPORTS, AND PENETRATIONS

PART 1 GENERAL

1.01. WORK INCLUDED

A. Work Included:

1. Conduit supports.

2. Formed steel channel.

3. Spring steel clips.

4. Sleeves.

5. Mechanical sleeve seals.

6. Firestopping relating to electrical work.

7. Firestopping accessories.

8. Equipment bases and supports.

1.02. REFERENCES

A. ASTM International:

1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

B. Factory Mutual System:

1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

C. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.

D. Underwriters Laboratories Inc.:

1. UL 263 - Fire Tests of Building Construction and Materials.

2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

3. UL 1479 - Fire Tests of Through-Penetration Firestops.

4. UL - Fire Resistance Directory.

E. Intertek Testing Services (Warnock Hersey Listed):

1. WH - Certification Listings.

1.03. DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.04. SYSTEM DESCRIPTION

A. Firestopping Materials: ASTM E119, ASTM E814, UL 263, UL 1479 to achieve fire ratings as noted on Drawings for adjacent construction, but not less than 1 hour fire rating.

1. Ratings may be 3-hours for firestopping in through-penetrations of 4-hour fire rated assemblies unless otherwise required by applicable codes.

B. Surface Burning: ASTM E84, UL 723 with maximum flame spread/smoke developed rating of 25/450.

C. Firestop interruptions to fire rated assemblies, materials, and components.

1.05. PERFORMANCE REQUIREMENTS

A. Firestopping: Conform to applicable code FM, UL, WH for fire resistance ratings and surface burning characteristics.

B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.06. SUBMITTALS

A. Shop Drawings: Indicate system layout with location and detail of hangers. All installations to adhere to seismic requirements.

B. Product Data:

1. Hangers and Supports: Submit manufacturers catalog data including load capacity.

2. Firestopping: Submit data on product characteristics, performance and limitation criteria.

C. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.

D. Design Data: Indicate load carrying capacity of all hangers and supports.

E. Manufacturer's Installation Instructions:

1. Hangers and Supports: Submit special procedures and assembly of components.

2. Firestopping: Submit preparation and installation instructions.

F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

G. Engineering Judgements: For conditions not covered by UL listed designs, submit judgements by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements and structural integrity of conduit, kindork, trapeze mounts, etc.

H. Seismic considerations: the Building Code of the State of New York, latest edition (including amendments) shall be in effect. Submit shop drawings for all electrical supports and anchors that include seismic restraint calculations and details as required to meet earthquake design data indicated on the structural drawings. Calculations and details, if required, shall be designed and stamped by a New York registered professional engineer retained by the Contractor.

1.07. QUALITY ASSURANCE

A. Perform Work in accordance with State of New York standards for electrical installations and seismic requirements.

B. Maintain one copy of each document on site.

1.08. QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum three years documented experience.

1.09. PRE-INSTALLATION MEETINGS

A. Convene minimum one week prior to commencing work of this section.

1.10. DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.

B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.11. ENVIRONMENTAL REQUIREMENTS

A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.

B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.

C. Provide ventilation in areas to receive solvent cured materials.

PART 2 PRODUCTS

2.01. CONDUIT SUPPORTS

A. Manufacturers:

1. Allied Tube & Conduit Corp.

2. Electroline Manufacturing Company.

3. O-Z Gedney Co.

B. Hanger Rods: Threaded high tensile strength hot-dipped, galvanized carbon steel with free running threads.

C. Beam Clamps: Galvanized Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.

D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.

E. Conduit clamps - general purpose: One hole malleable iron for surface mounted conduits.

F. Cable Ties: High strength nylon temperature rated to 185 degrees F. Self-locking.

G. Materials: supports shall be hot-dipped, galvanized steel for unclassified areas. Provide type 316 stainless steel or PVC coated galvanized steel materials for wet, hazardous and outdoor areas.

2.02. FORMED STEEL CHANNEL

A. Manufacturers:

1. Kindorf.

B. Product Description: Hot-dipped galvanized 12 gage thick steel for unclassified areas. With holes 1-1/2 inches on center. Provide type 316 stainless steel or PVC coated galvanized steel 12 gage thick in wet, hazardous and outdoor areas.

2.03. SLEEVES

A. Furnish materials in accordance with State of New York standards.

B. Sleeves for conduit through Non-fire Rated Floors: 18 gage thick galvanized steel.

C. Sleeves for conduit through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

D. Sleeves for conduit through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.

E. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.04. MECHANICAL SLEEVE SEALS

A. Manufacturers:

1. Thunderline Link-Seal, Inc.

2. NMP Corporation.

3. Substitutions:

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.05. FIRESTOPPING

A. Manufacturers:

1. Dow Corning Corp.

2. Fire Trak Corp.

3. Hilti Corp.

4. International Protective Coating Corp.

5. 3M fire Protection Products.

6. Specified Technology, Inc.

B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.

1. Silicone Firestopping Elastomeric Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.

2. Foam Firestopping Compounds: Single component foam compound.

3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.

4. Fiber Stuffing and Sealant Firestopping: Composite of ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.

5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.

6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.

7. Firestop Pillows: Formed mineral fiber pillows.

C. Color: As selected from manufacturer=s full range of colors.

2.06. FIRESTOPPING ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Dam Material: Permanent:

1. Mineral fiberboard.

2. Mineral fiber matting.

3. Sheet metal.

4. Plywood or particle board.

5. Alumina silicate fire board.

C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

D. General:

1. Furnish UL listed products or products tested by independent testing laboratory.

2. Select products with rating not less than rating of wall or floor being penetrated.

E. Non-Rated Surfaces:

1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.

2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify openings are ready to receive sleeves.

B. Verify openings are ready to receive firestopping.

3.02. PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Install backing, damming materials to arrest liquid material leakage.

D. Obtain permission from Engineer before using powder-actuated anchors.

E. Do not drill or cut structural members.

3.03. INSTALLATION - HANGERS AND SUPPORTS

A. Anchors and Fasteners:

1. Concrete Structural Elements: Provide expansion anchors.

2. Steel Structural Elements: Provide beam clamps.

3. Concrete Surfaces: Provide expansion anchors.

4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts and hollow wall fasteners.

5. Solid Masonry Walls: Provide expansion anchors.

6. Sheet Metal: Provide sheet metal screws.

7. Wood Elements: Provide wood screws.

B. Inserts:

1. Install inserts for placement in concrete forms.

2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.

4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

C. Install conduit and raceway support and spacing in accordance with NEC.

D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.

E. Install multiple conduit runs on common hangers.

F. Supports:

1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.

2. Install surface mounted cabinets and panelboards with minimum of four anchors.

3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch off wall.

4. Support vertical conduit at every floor.

3.04. INSTALLATION - FIRESTOPPING

A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.

B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.

D. Compress fibered material to maximum 40 percent of its uncompressed size.

E. Remove dam material after firestopping material has cured. Dam material to remain.

F. Fire Rated Surface:

1. Seal opening at floor, wall, partition, ceiling, and roof as follows:

a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.

b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.

c. Pack void with backing material.

d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

2. Where conduit, wireway, and trough penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.

G. Non-Rated Surfaces:

1. Seal opening through non-fire rated wall, partition, floor, ceiling, and roof opening as follows:

a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.

b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.

c. Install type of firestopping material recommended by manufacturer.

2. Install escutcheons, floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.

3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.

4. Interior partitions: Seal pipe penetrations at all rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.05. INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Provide housekeeping pads of concrete, minimum 3 inches thick with a 1" 45 degree chamfer and extending 3 inches beyond supported equipment.

B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of steel members formed steel channel. Brace and fasten with flanges bolted to structure.

3.06. INSTALLATION - SLEEVES

A. Exterior watertight entries: Seal with adjustable interlocking rubber links.

B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.

C. Set sleeves in position in forms. Provide reinforcing around sleeves.

D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

E. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.

F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with stuffing fire stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

G. Install stainless steel escutcheons at finished surfaces.

3.07. FIELD QUALITY CONTROL

A. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.08. CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.09. PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 16075

ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01. WORK INCLUDED

A. Work Included:

1. Nameplates.

2. Labels.

3. Wire markers.

4. Conduit markers.

5. Underground Warning Tape.

6. Lockout Devices.

1.02. SUBMITTALS

A. Product Data:

1. Submit manufacturer’s catalog literature for each product required.

2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.

B. Samples:

1. Submit two samples of each type of identification products applicable to project.

2. Submit two nameplates, 4 x 4 inch in size illustrating materials and engraving quality.

C. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

1.03. CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of tagged devices; include tag numbers.

1.04. QUALITY ASSURANCE

A. Perform Work in accordance with State of New York standard.

1.05. QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.06. DELIVERY, STORAGE, AND HANDLING

A. Accept identification products on site in original containers. Inspect for damage.

B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

C. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.07. ENVIRONMENTAL REQUIREMENTS

A. Install nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

1.08. EXTRA MATERIALS

A. Furnish two containers of spray-on adhesive.

PART 2 PRODUCTS

2.01. NAMEPLATES

A. Furnish materials in accordance with State of New York standards.

B. Product Description: Laminated three-layer plastic with engraved black letters on white contrasting background color.

C. Letter Size:

1. 1/8 inch high letters for identifying individual equipment and loads.

2. 1/4 inch high letters for identifying grouped equipment and loads.

3. inch high letters for identifying

D. Minimum nameplate thickness: 1/8 inch.

2.02. LABELS

A. Furnish materials in accordance with State of New York standards.

B. Labels: Embossed adhesive tape, with 3/16 inch white letters on black background.

2.03. WIRE MARKERS

A. Furnish materials in accordance with State of New York standards.

B. Description: Split sleeve or tubing type wire markers.

C. Legend:

1. Power and Lighting Circuits: Branch circuit or feeder number as indicated on Drawings.

2. Control Circuits: Control wire number as indicated on schematic and interconnection diagrams or shop drawings.

2.04. CONDUIT AND RACEWAY MARKERS

A. Furnish materials in accordance with State of New York standards.

B. Description: Nameplate fastened with straps.

C. Color:

1. 480 Volt System: White lettering on black background.

2. 208 Volt System: White lettering on black background.

3. Fire Alarm System: Red lettering on white background.

4. Intercom and Telephone System: Blue lettering on white background.

D. Legend:

1. 480 Volt System: 480 VOLTS.

2. 208 Volt System: 208 VOLTS.

3. Fire Alarm System: FIRE ALARM.

4. Telephone System: TELEPHONE.

5. Intercom System: INTERCOM.

2.05. UNDERGROUND WARNING TAPE

A. Description: 4 inch wide plastic tape, detectable type, colored red with suitable warning legend describing buried electrical lines.

2.06. LOCKOUT DEVICES

A. Lockout Hasps:

1. Anodized aluminum hasp with erasable label surface; size minimum 7-1/4 x 3 inches.

PART 3 EXECUTION

3.01. PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02. EXISTING WORK

A. Install identification on existing equipment to remain in accordance with this section.

B. Install identification on unmarked existing equipment.

C. Replace lost nameplates, labels, and markers.

3.03. INSTALLATION

A. Install identifying devices after completion of painting.

B. Nameplate Installation:

1. Install nameplate parallel to equipment lines.

2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.

3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.

4. Secure nameplate to equipment front using screws or adhesive.

5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.

6. Install nameplates for the following:

a. Switchboards.

b. Panelboards.

c. Transformers.

d. Service disconnects.

e. Fire alarm.

f. Switchgear.

g. Transfer switches.

h. Intercom.

i. Generators.

C. Label Installation:

1. Install label parallel to equipment lines.

2. Install label for identification of individual control device stations.

3. Install labels for permanent adhesion and seal with clear lacquer.

D. Wire Marker Installation:

1. Install wire marker for each conductor at panelboard gutters, pull boxes, outlet and junction boxes and each load connection.

2. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.

3. Install labels at data outlets identifying patch panel and port designation.

E. Conduit Marker Installation:

1. Install conduit marker for each conduit longer than 6 feet.

2. Conduit Marker Spacing: 20 feet on center.

3. Raceway Painting: Identify conduit using field painting

a. Paint colored band on each conduit longer than 6 feet.

b. Paint bands 20 feet on center.

c. Color:

1) 480 Volt System: Blue.

2) 208 Volt System: Yellow.

3) Fire Alarm System: Red.

4) Telephone System: Green.

F. Underground Warning Tape Installation:

1. Install underground warning tape along length of each underground conduit, raceway, or cable 6 to 8 inches below finished grade, directly above buried conduit, raceway, or cable.

END OF SECTION

SECTION 16095

ELECTRICAL REMOVALS

PART 1 GENERAL

1.01. WORK INCLUDED

A. Work Included:

1. Removal of existing electrical equipment, wiring, and conduit in areas to be upgraded; removal of designated construction; dismantling, cutting and alterations for completion of the Work.

2. Disposal of materials.

3. Storage of removed materials.

4. Identification of utilities.

5. Salvaged items.

6. Protection of items to remain as indicated on Drawings.

7. Relocate existing equipment to accommodate construction.

B. Related Sections:

1. Section 16010 - General Electrical Requirements.

1.02. CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of capped utilities, conduits, and equipment abandoned in place.

1.03. QUALITY ASSURANCE

A. Perform Work in accordance with State of New York standards.

1.04. PRE-INSTALLATION MEETINGS

A. Convene minimum one week prior to commencing work of this section.

1.05. COORDINATION

A. Conduit removals to minimize interference with adjacent building areas.

B. Coordinate removals work with all other contractors and subcontractors.

C. Coordinate and sequence removals so as not to cause shutdown of operation of surrounding areas.

D. Shut-down Periods:

1. Arrange timing of shut-down periods in service panels with Owner/Engineer. Do not shut down any utility without prior written approval.

2. Keep shut-down period to minimum or use intermittent period as directed by Owner/Engineer.

3. Maintain life-safety systems in full operation in occupied facilities, or provide notice minimum three days in advance of any shutdown of these systems.

E. Identify salvage items in cooperation with Owner. Owner has right of first refusal to keep all existing equipment.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify wiring and equipment indicated to be removed serve only abandoned facilities.

B. Verify termination points for removed services.

C. The Contractor shall visit the site prior to bid.

D. Verify field measurements and circuiting arrangements are as shown on the drawings.

E. Beginning of removals means installer accepts existing conditions.

3.02. PREPARATION

A. Erect, and maintain temporary safeguards, including warning signs and lights, barricades, and similar measures, for protection of the public, Owner, Contractor's employees, and existing improvements to remain.

B. Temporary egress signage and emergency lighting

3.03. REMOVALS

A. Removal Drawings are based on casual field observation and existing record documents. Report discrepancies to Owner, Engineer before disturbing existing installation.

B. Remove exposed abandoned conduit, wire including abandoned conduit, above accessible ceiling finishes. Cut conduit 1" below walls and floors, and patch surfaces to remove existing.

C. Remove conduit, wire, boxes, and fastening devices to avoid any interference with new installation.

D. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

E. Reconnect equipment being disturbed by renovation work and required for continue service to next to upstream device or nearest available panel.

F. Disconnect or shut off service to areas where electrical work is to be removed. Remove electrical fixtures, equipment, and related switches, outlets, conduit and wiring which are not part of final project. Provide blank cover for abandoned outlets where devices have been removed.

G. Install temporary wiring and connections to maintain existing systems in service during construction.

H. Perform work on energized equipment or circuits with experienced and trained personnel.

I. Remove, relocate, and extend existing installations to accommodate new construction as indicated on the drawings.

J. Repair adjacent construction and finishes damaged during demolition and extension work.

K. Remove exposed abandoned grounding and bonding components, fasteners and supports, and electrical identification components, including abandoned components above accessible ceiling finishes. Cut embedded support elements flush with walls and floors.

L. Clean and repair existing equipment to remain or to be reinstalled.

M. Protect and retain power to existing active equipment remaining.

N. Cap abandoned empty conduit at both ends.

O. Disconnect electrical systems scheduled for removal in a phased and orderly manner.

P. If any downstream devices, circuits, etc., that are required to remain energized become de-energized by this work, it shall be the Contractor=s responsibility to reconnect them to permanent circuits. Any additional wiring, raceways, needed shall be provided and installed at no extra cost.

3.04. EXISTING PANELBOARDS

A. Ring out circuits in existing panel affected by the Work. Where additional circuits are needed, reuse circuits available for reuse. Install new breakers where required.

B. Tag unused circuits as spare.

C. Where existing circuits are indicated to be reused, use sensing measuring devices to verify circuits feeding Project area are not in use.

D. Remove existing wire no longer in use from panel to equipment.

E. Provide new updated typed directories where more than three circuits have been modified or rewired.

3.05. SALVAGE ITEMS

A. Remove and protect items indicated on Drawings to be salvaged and turn over to Owner.

B. Items of salvageable value may be removed as work progresses. Transport salvaged items from site as they are removed to area as specified by Owner.

3.06. REUSABLE ELECTRICAL EQUIPMENT

A. Carefully remove equipment, materials, or fixtures which are to be reused.

B. Disconnect, remove, or relocate existing electrical material and equipment interfering with new installation.

C. Relocate existing lighting fixtures as indicated on Drawings. Clean fixtures and re-lamp. Test fixture to see if it is in good working condition before installation at new location.

3.07. CLEANING

A. Remove demolished materials as work progresses. Legally dispose.

B. Keep workplace neat.

3.08. PROTECTION OF FINISHED WORK

A. Any equipment damaged during construction shall be replaced by said Contractor at no expense to the Owner.

END OF SECTION

SECTION 16123

BUILDING WIRE AND CABLE

PART 1 GENERAL

1.01. WORK INCLUDED

A. Section includes building wire and cable; service entrance cable; and wiring connectors and connections.

1.02. REFERENCES

A. NECA (National Electrical Contractors Association) - Standard of Installation.

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. ANSI/NFPA 70 - National Electric Code.

1.03. SYSTEM DESCRIPTION

A. Product Requirements: Provide products as follows:

1. Solid conductor for feeders and branch circuits 10 AWG and smaller.

2. Stranded conductors for control circuits.

3. Conductor not smaller than 12 AWG for power and lighting circuits.

4. Conductor not smaller than 14 AWG for discrete control circuits.

5. Conductors not smaller than 16 AWG for analog control circuits.

6. Conductor not smaller than 24 AWG Cat 6 for communications, 14 TW/SH pair for Intercom.

7. 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet.

8. 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet.

B. Wiring Methods: Provide the following wiring methods:

1. Concealed Dry Interior Locations: Use only copper building wire, Type XHHW-2 insulation, in raceway.

2. Exposed Dry Interior Locations: Use only copper building wire, Type XHHW-2 insulation, in raceway.

3. Above Accessible Ceilings: Use only copper building wire, Type XHHW-2 insulation, in raceway.

4. Wet Locations: Use only copper building wire, Type XHHW-2 insulation, in raceway.

5. Hazardous Locations: Use only copper building wire, Type XHHW-2 insulation, in raceway.

6. Exterior Locations: Use only copper building wire, Type XHHW-2 insulation, in raceway.

7. Underground Locations: Use only building wire, Type XHHW-2 insulation, in raceway.

1.04. DESIGN REQUIREMENTS

A. Conductor sizes are based on copper.

1.05. SUBMITTALS

A. Product Data: Submit for building wire and each cable assembly type.

B. Samples:

1. Submit 1 each, 18 inch length of cable assembly from each reel.

2. Select each length to include complete set of manufacturer markings.

3. Attach tag indicating cable size and application information.

C. Test Reports: Indicate procedures and values obtained.

1.06. CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of components and circuits.

1.07. QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.08. FIELD MEASUREMENTS

A. Verify field measurements are as indicated on Drawings.

1.09. COORDINATION

A. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.

B. Wire and cable routing indicated is approximate unless dimensioned. Include wire and cable lengths within 10 feet of length shown.

PART 2 PRODUCTS

2.01. BUILDING WIRE

A. Manufacturers:

1. Southwire.

2. Essex Group Inc.

3. General Cable Co.

B. Product Description: Single conductor insulated wire.

C. Conductor: Copper.

D. Insulation: 600 volt rating.

E. Insulation: Cross-linked polymer, thermosplastic thermosetting material rated 75 degrees C, type XHHW-2.

2.02. CONTROL WIRING

A. Manufacturers:

1. Belden.

B. Product Description: multi-conductor, individually insulated conductors, with overall PVC jacket, foil shielding and drain wire.

C. Insulation: 300 volt rating

D. Conductor: Copper.

2.03. ETHERNET WIRING

A. Manufacturers:

1. Belden.

2. Berk-Tek.

B. Product Description: four twisted pairs of individually insulated conductors with overall PVC jacket and foil shielding. CAT-6 rated, suitable for outside plant use.

2.04. WIRING CONNECTORS

A. Solderless Pressure Connectors:

1. Burndy Electrical.

2. T&B Long Barrel.

B. Spring Wire Connectors:

1. 3M.

2. Ideal.

C. Compression Connectors:

1. Burndy Electrical.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify interior of building has been protected from weather.

B. Verify mechanical work likely to damage wire and cable has been completed.

C. Verify raceway installation is complete and supported.

3.02. PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.03. EXISTING WORK

A. Remove exposed abandoned wire and cable. Patch surfaces where removed cables pass through building finishes.

B. Provide access to existing wiring connections remaining active and requiring access.

3.04. INSTALLATION

A. Route wire and cable to meet Project conditions.

B. Install wire and cable in accordance with the NECA AStandard of Installation.@

C. Neatly train and lace wiring inside boxes, equipment, and panelboards.

D. Identify and color code wire and cable under provisions of Section 16075. Identify each conductor with its circuit number or other designation indicated.

E. Use compression connectors for copper conductor splices and taps, 6 AWG and larger. Heat shrink uninsulated conductors to 150 percent of insulation rating of conductor.

F. Special Techniques--Building Wire in Raceway:

1. Pull conductors into raceway at same time.

2. Install building wire 4 AWG and larger with pulling equipment.

3. Use suitable wire pulling lubricant.

G. Special Techniques - Wiring Connections:

1. Clean conductor surfaces before installing lugs and connectors.

2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.

4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.

5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.

6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

7. Install solid conductor for feeders and branch circuits 10 AWG and smaller.

8. Install stranded conductors for branch circuits 10 AWG and smaller. However, when stranded conductors are used in lieu of solid, then install crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under screws.

H. Line side conductors shall not be installed in the same raceway as load side conductors.

I. No piece of equipment shall be used as a raceway for conductors not terminating in that piece of equipment.

3.05. WIRE COLOR

A. General

1. For wire sizes 10 AWG and smaller, install wire colors in accordance with the following:

a. Black and red for single phase circuits at 120/240 volts.

b. Black, red, and blue for circuits at 120/208 volts single or three phase.

c. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.

2. For wire sizes 8 AWG and larger, identify wire with colored tape at terminals, splices and boxes. Colors are as follows:

a. Black and red for single phase circuits at 120/240 volts.

b. Black, red, and blue for circuits at 120/208 volts single or three phase.

c. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.

3. Fire Alarm wire to be red, communications white, intercom grey.

B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number.

C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.

D. Feeder Circuit Conductors: Uniquely color code each phase.

E. Ground Conductors:

1. For 6 AWG and smaller: Green.

2. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

3.06. FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

C. Measure tightness of bolted connections and compare torque measurements with manufacturer’s recommended values.

D. Verify continuity of each branch circuit conductor.

E. All wiring shall be point-to-point field verified.

F. All building feeders shall be megger tested prior to being placed in service. Provide type written field report for record.

G. 120V branch circuits are not required to be megger tested.

END OF SECTION

SECTION 16130

RACEWAY AND BOXES

PART 1 GENERAL

1.01. WORK INCLUDED

A. Section includes conduit wireways, outlet boxes, pull and junction boxes.

B. Related Sections:

1. Section 16123 - Building Wire and Cable.

1.02. REFERENCES

A. American National Standards Institute:

1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.

2. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).

B. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.

3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.

4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.

5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.

6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.

7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.03. SYSTEM DESCRIPTION

A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.

B. Underground More than five (5) feet outside Foundation Wall: Provide nonmetallic conduit, concrete encased.

C. Underground Within five (5) feet from Foundation Wall: Provide PVC coated rigid steel conduit, into building.

D. In or Under Slab on Grade: Provide PVC coated rigid steel conduit. Provide cast or nonmetallic metal boxes.

E. Outdoor Locations, Above Grade: Provide PVC coated rigid metal conduit. Provide PVC coated cast metal or nonmetallic outlet, pull, and junction boxes to match material.

F. In Slab Above Grade: Provide PVC coated rigid steel conduit. Provide cast nonmetallic boxes.

G. Wet Locations: Provide PVC coated rigid metal conduit. Provide PVC coated cast metal outlet, junction, and pull boxes to match material. Provide flush mounting outlet box in finished areas.

H. Hazardous Locations: Provide PVC coated rigid metal conduit. Provide PVC coated cast metal or nonmetallic outlet, junction, and pull boxes to match material. Provide flush mounting outlet box in finished areas.

I. Concealed Dry Locations: Provide rigid steel conduit. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

J. Exposed Dry Locations: Provide rigid steel conduit. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes. Cable tray as indicated on the drawings is to be provided.

1.04. DESIGN REQUIREMENTS

A. Minimum Raceway Size: 3/4 inch unless otherwise specified.

1.05. SUBMITTALS

A. Product Data: Submit for the following:

1. Flexible metal conduit.

2. Nonmetallic conduit.

3. Raceway fittings.

4. Conduit bodies.

5. Pull and junction boxes.

B. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

C. Raceway and Boxes Layout Drawings: Contractor shall submit scaled drawings depicting layout of all raceways and boxes to be installed prior to the start of installation. Drawings shall be scaled, 11x17 minimum. Drawings shall denote conduit size, routing and wiring contents.

1. The Contractor shall submit copies of shop drawings at ¼ inch scale or larger showing all conduit mains, including connections to equipment, and all equipment layouts and shall obtain approval before proceeding with the work. Shop drawings shall be accurately dimensioned so that conduit clears all structural members and other work incorporated in the project. The Contractor shall take all shop drawing measurements at the building.

1.06. CLOSEOUT SUBMITTALS

A. Project Record Documents:

1. Record actual routing of conduits larger than two (2") inch trade size.

2. Record actual locations and mounting heights of outlet, pull, and junction boxes.

1.07. DELIVERY, STORAGE, AND HANDLING

A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

B. Protect PVC conduit from sunlight.

1.08. COORDINATION

A. Coordinate installation of outlet boxes for equipment connected under Section 16140.

B. Coordinate mounting heights, orientation and locations of outlets.

PART 2 PRODUCTS

2.01. METAL CONDUIT

A. Manufacturers:

1. Triangle.

2. Wheatland Tube Company.

3. Steel City.

B. Rigid Steel Conduit: ANSI C80.1.

C. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.02. PVC COATED METAL CONDUIT

A. Manufacturers:

1. Ocal.

2. Perma-Cote.

3. Plastibond.

B. Product Description: NEMA RN 1; rigid steel conduit with external PVC coating, 40 mil thick exterior coating, 2 mil think interior coating.

C. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external and internal PVC coating to match conduit.

2.03. LIQUID TIGHT FLEXIBLE METAL CONDUIT

A. Manufacturers:

1. Greenfield.

2. AFC.

B. Product Description: Interlocked steel construction, with overall PVC jacket. Type UA-UL.

C. Fittings: NEMA FB 1.

2.04. NONMETALLIC CONDUIT

A. Manufacturers:

1. Carlon Electrical Products.

2. Appleton.

B. Product Description: NEMA TC 2; Schedule 40, PVC.

C. Fittings and Conduit Bodies: NEMA TC 3.

2.05. WIREWAY

A. Manufacturers:

1. Hoffman.

2. Electromate.

3. The Austin Company.

B. Product Description: General purpose, Oiltight and dust-tight, NEMA 12 wireway.

C. Knockouts: Manufacturer's standard, None, Bottom only.

D. Size: 6 x 6 inch (minimum) or as indicated on the drawings; size and length as indicated on Drawings.

E. Cover: Hinged cover with full gaskets.

F. Connector: Slip-in, Flanged.

G. Fittings: Lay-in type with removable top, bottom, and side; captive screws, drip shield.

H. Finish: Rust inhibiting primer coating with gray enamel finish.

2.06. OUTLET BOXES

A. Manufacturers:

1. Appleton.

2. Hubbell Wiring Devices.

3. Thomas & Betts Corp.

4. Crouse Hinds.

B. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.

1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch male fixture studs where required.

2. Concrete Ceiling Boxes: Concrete type.

3. Sheet metal boxes shall only be used in unclassified areas.

C. Nonmetallic Outlet Boxes: NEMA OS 2.

D. Cast Boxes: NEMA FB 1, Type FD, cast feralloy. Furnish gasketed cover by box manufacturer. Furnish threaded hubs.

E. Wall Plates for Finished Areas: As specified in Section 16140.

F. Wall Plates for Unfinished Areas: Furnish gasketed cover.

2.07. EXPLOSIONPROOF FLEXIBLE COUPLINGS

A. Manufacturers: Appleton, Crouse Hinds.

B. Product Description:

1. Explosionproof, dust-ignition proof, watertight.

2. Electrical conductivity equal to rigid conduit of similar length, no bonding jumper required.

3. Outer bronze or stainless steel braid, inner brass or stainless steel core with insulating liner.

4. Suitable for use in Class 1, Division 1, Group D hazardous locations.

5. UL-1203 listed.

6. 12 inch minimum length.

7. Utilize for final connection to motors and vibrating equipment in hazardous locations.

2.08. PULL AND JUNCTION BOXES

A. Manufacturers:

1. Appleton.

2. Hubbell Wiring Devices.

3. Thomas & Betts Corp.

4. Crouse Hinds.

B. Sheet Metal Boxes: NEMA OS 12, galvanized steel.

C. Hinged Enclosures: As specified in Section 16131.

D. Surface Mounted Cast Metal Box: NEMA 250, Type 12, 4, 4X, 6; flat-flanged, surface mounted junction box:

1. Material: Galvanized cast iron, Cast aluminum.

2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.

E. In-Ground Cast Metal Box: NEMA 250, Type 6, outside, inside flanged, recessed cover box for flush mounting:

1. Material: Galvanized cast iron, Cast aluminum.

2. Cover: Smooth, Nonskid cover with neoprene gasket and stainless steel cover screws.

3. Cover Legend: "ELECTRIC".

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.02. EXISTING WORK

A. Remove exposed abandoned raceway. Cut raceway flush with walls and floors, and patch surfaces.

B. Remove concealed abandoned raceway to its source.

C. Maintain access to existing boxes and other installations remaining active and requiring access.

D. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified.

E. Clean and repair existing raceway and boxes to remain.

3.03. INSTALLATION

A. Install Work in accordance with NECA - AStandards of Installation.@

B. Ground and bond raceway and boxes in accordance with Section 16060.

C. Fasten raceway and box supports to structure and finishes in accordance with Section 16070.

D. Identify raceway and boxes in accordance with Section 16075.

E. Arrange raceway and boxes to maintain headroom and present neat appearance.

3.04. INSTALLATION - RACEWAY

A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.

B. Arrange raceway supports to prevent misalignment during wiring installation.

C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

D. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 16070; provide space on each for 25 percent additional raceways.

E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports

F. Do not attach raceway to ceiling support wires or other piping systems.

G. Construct wireway supports from steel channel specified in Section 16070.

H. Route exposed raceway parallel and perpendicular to walls.

I. Route conduit in and under slab from point-to-point.

J. Maximum Size Conduit in Slab Above Grade: 3/4. Do not cross conduits in slab larger than 3/4 inch trade size.

K. Maintain clearance between raceway and piping for maintenance purposes.

L. Maintain 12 inch clearance between raceway and surfaces with temperatures exceeding 104 degrees F.

M. Cut conduit square using saw or pipe cutter; de-burr cut ends.

N. Bring conduit to shoulder of fittings; fasten securely.

O. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.

P. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

Q. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install hydraulic one-shot bender to fabricate factory elbows for bends in metal conduit larger than 2 inch size.

R. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.

S. Install fittings to accommodate expansion and deflection where raceway crosses seismic, control and expansion joints.

T. Install 2@ pull or cord in each empty raceway except sleeves and nipples.

U. Install suitable caps to protect installed conduit against entrance of dirt and moisture.

V. Close ends and unused openings in wireway.

W. All conduits shall be PVC coated rigid steel 6-inch above and below concrete floors, pads. Spray exposed surfaces with PVC.

3.05. INSTALLATION - BOXES

A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings specified in section for outlet device.

B. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.

C. Orient boxes to accommodate wiring devices oriented as specified in Section 16140.

D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

E. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

F. Support boxes independently of conduit.

G. Install gang box where more than one device is mounted together. Do not use sectional box.

3.06. INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements.

B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation. See specification 07530 – EPDM Roof System Repair and Restoration for additional coordination and requirements.

C. Locate outlet boxes to allow luminaires positioned as indicated on Drawings.

D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.07. ADJUSTING

A. Install knockout closures in unused openings in boxes.

3.08. CLEANING

A. Clean interior of boxes to remove dust, debris, and other material.

B. Clean exposed surfaces and restore finish.

END OF SECTION

SECTION 16131

CABINETS AND ENCLOSURES

PART 1 GENERAL

1.01. WORK INCLUDED

A. Section includes hinged cover enclosures, cabinets, terminal blocks, and accessories.

1.02. REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

2. NEMA ICS 4 - Industrial Control and Systems: Terminal Blocks.

1.03. SUBMITTALS

A. Product Data: Submit manufacturer's standard data for enclosures, cabinets, and terminal blocks.

B. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.04. QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three (3) years documented experience.

1.05. EXTRA MATERIALS

A. Furnish two (2) of each key.

PART 2 PRODUCTS

2.01. HINGED COVER ENCLOSURES

A. Manufacturers:

1. Carlon Electrical Products.

2. Hoffman.

3. Stahlin Electromate.

B. Construction: NEMA 250, Type 12 (minimum), 4X stainless steel enclosure as indicated on the drawings in wet and outdoor locations. NEMA 7 enclosures as indicated on the drawings in hazardous locations.

C. Covers: Continuous hinge, held closed by flush latch operable by key hasp and staple for padlock.

D. Furnish interior metal panel for mounting terminal blocks and electrical components; finish with white enamel.

E. Enclosure Finish: Manufacturer's standard enamel or none for stainless steel enclosure.

2.02. CABINETS

A. Manufacturers:

1. Carlon Electrical Products.

2. Hoffman.

3. Stahlin Electromate.

B. Boxes: Galvanized steel with removable end walls.

C. Box Size: As indicated on the drawings.

D. Backboard: Furnish 3/4 inch thick plywood backboard for mounting terminal blocks. Paint matte white.

E. Fronts: Steel with concealed trim clamps, door with concealed hinge, and flush lock keyed to match branch circuit panelboard. Finish with gray baked enamel.

F. Knockouts: as required.

G. Furnish metal barriers to form separate compartments wiring of different systems and voltages.

H. Furnish accessory feet for free-standing equipment.

2.03. TERMINAL BLOCKS

A. Manufacturers:

1. Ilsco.

2. Square D.

B. Terminal Blocks: NEMA ICS 4.

C. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.

D. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.

E. Furnish ground bus terminal block, with each connector bonded to enclosure.

PART 3 EXECUTION

3.01. EXISTING WORK

A. Remove abandoned cabinets and enclosures. Patch surfaces.

B. Maintain access to existing cabinets and enclosures and other installations remaining active and requiring access. Modify installation.

C. Extend existing cabinets and enclosures using materials and methods compatible with existing electrical installations, or as specified.

D. Clean and repair existing cabinets and enclosures to remain or to be reinstalled.

3.02. INSTALLATION

A. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner in accordance with Section 16070.

B. Install cabinet fronts plumb.

3.03. CLEANING

A. Clean electrical parts to remove conductive and harmful materials.

B. Remove dirt and debris from enclosure.

C. Clean finishes and touch up damage.

END OF SECTION

SECTION 16140

WIRING AND DEVICES

PART 1 GENERAL

1.01. WORK INCLUDED

A. Section includes wall switches; receptacles and device plates.

1.02. REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA WD 1 - General Requirements for Wiring Devices.

2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

3. NECA - Standard of Installation.

4. NFPA 70 - National Electrical Code.

1.03. SUBMITTALS

A. Product Data: Submit manufacturer's catalog information showing dimensions, colors, and configurations.

B. Samples: Submit two samples of each wiring device and wall plate illustrating materials, construction, color, and finish.

1.04. QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.05. EXTRA MATERIALS

A. Furnish two of each style, size, and finish wall plate.

B. Provide five spare wiring devices for each specified.

PART 2 PRODUCTS

2.01. WALL SWITCHES

A. Manufacturers:

1. Hubbell.

2. Leviton.

3. Pass & Seymour.

B. Product Description: NEMA WD 1, Heavy-Duty, General-Duty, AC only general-use snap switch.

C. Body and Handle: Brown plastic with toggle rocker handle.

D. Indicator Light: Separate pilot strap; red color lens, where shown on the drawings.

E. Ratings:

1. Voltage: 120-277 volts, AC.

2. Current: 20 amperes.

2.02. RECEPTACLES

A. Manufacturers:

1. Hubbell.

2. Leviton.

3. Pass & Seymour.

B. Product Description: NEMA WD 1, Heavy-duty general use receptacle.

C. Device Body: Brown plastic.

D. Configuration: NEMA WD 6, type as indicated on Drawings.

E. Convenience Receptacle: Type 5-15R.

F. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

G. Telephone Jack: RJ11

2.03. WALL PLATES

A. Manufacturers:

1. Arrow Hart Wiring Devices.

2. Eagle Electric.

3. Siemens Co.

4. Square D.

B. Cover Plate: 304 stainless steel with gaskets

C. Weatherproof Cover Plate: Stainless steel plate with threaded and gasketed device cover.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify outlet boxes are installed at proper height.

B. Verify wall openings are neatly cut and completely covered by wall plates.

C. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

D. Allow 10 foot location change for all devices.

3.02. PREPARATION

A. Clean debris from outlet boxes.

3.03. EXISTING WORK

A. Disconnect and remove abandoned wiring devices.

B. Modify installation to maintain access to existing wiring devices to remain active.

C. Clean and repair existing wiring devices to remain or to be reinstalled.

3.04. INSTALLATION

A. Install devices plumb and level.

B. Install switches with OFF position down.

C. Install receptacles with grounding pole on top.

D. Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor.

E. Install decorative plates on switch, receptacle, and blank outlets in finished areas.

F. Connect wiring devices by wrapping solid conductor around screw terminal. Install stranded conductor for branch circuits 10 AWG and smaller. When stranded conductors are used in lieu of solid, use crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under device screws.

G. Use jumbo size plates for outlets installed in masonry walls.

H. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

3.05. INTERFACE WITH OTHER PRODUCTS

A. Coordinate locations of outlet boxes provided under Section 16130 to obtain mounting heights as specified and as indicated on drawings.

B. Install wall switch 48 inches above finished floor.

C. Install convenience receptacle 24 inches above finished floor.

3.06. FIELD QUALITY CONTROL

A. Inspect each wiring device for defects.

B. Operate each wall switch with circuit energized and verify proper operation.

C. Verify each receptacle device is energized.

D. Test each receptacle device for proper polarity.

E. Test each GFCI receptacle device for proper operation.

3.07. ADJUSTING

A. Adjust devices and wall plates to be flush and level.

3.08. CLEANING

A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

SECTION 16210

ELECTRICAL UTILITY SERVICES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes arrangement with Utility Company for permanent electric services for the Tallman and Union Hill Pump Stations; payment of Utility Company charges for service; service provisions; and utility metering equipment.

1.02 SYSTEM DESCRIPTION

A. Utility Company: Orange & Rockland. Contact: Mr. Kevin Mei (845) 763-0868.

B. System Characteristics: 1200 ampere, 480Y/277 volts, three phase, four- wire, 60 Hertz.

C. Service Entrance: underground to pad mounted utility transformer.

1.03 SUBMITTALS

A. Submit Utility Company-prepared drawings.

B. Submit Engineer approved shop drawings to Utility Company for their approval as required.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with Utility Company written requirements.

B. Maintain one (1) copy of each document on site.

1.05 FIELD MEASUREMENTS

A. Verify field measurements are as indicated on Drawings Utility Company drawings.

1.06 COORDINATION

A. Coordinate with utility company, relocation of overhead or underground lines interfering with construction. Where power lines are to be temporarily relocated, bill utility costs, directly to Owner.

B. Contact utility company regarding charges related to service installation. Utility costs will be paid directly by Owner.

1.07 REGULATORY REQUIREMENTS

A. Confirm to requirements NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories, Inc., testing from acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.08 PRE-INSTALLATION MEETING

A. Convene at least one (1) week prior to commencing work of this section. Review service entrance requirements and details with Utility Company representative.

PART 2 PRODUCTS

2.01 UTILITY METERS

A. Furnished by Utility Company.

2.02 METERING PAN CABINET

A. Manufacturers: Must be a Utility approved manufacturer.

B. Size: As required by Utility.

C. Description: Sheet metal cabinet with hinged door conforming to Utility Company requirements, with provisions for locking and sealing with fused main service disconnect.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify service equipment is ready to be connected and energized.

3.02 EXISTING WORK

A. Disconnect abandoned service equipment and remove.

B. Maintain access to existing service equipment, boxes, metering equipment, and other installations remaining active and requiring access. Modify installation or provide access panel.

C. Extend existing service installations using materials and methods compatible with existing electrical installations, or as specified.

D. Clean and repair existing service equipment to remain or to be reinstalled.

3.03 INSTALLATION

A. Install metering transformer cabinets, transformer pad, customer utility pole at height in accordance with Utility Company requirements. Install drip loop in service conductors.

END OF SECTION

SECTION 16411

ENCLOSED SWITCHES

PART 1 GENERAL

1.01. SUMMARY

A. Section includes non-fusible switches.

1.02. REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA FU 1 - Low Voltage Cartridge Fuses.

2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.03. SUBMITTALS

A. Section 01300 - Submittals: Submittal procedures.

B. Product Data: Submit switch ratings and enclosure dimensions.

1.04. CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of enclosed switches and ratings of installed fuses.

1.05. QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years [documented] experience.

PART 2 PRODUCTS

2.01. NON-FUSIBLE SWITCH ASSEMBLIES

A. Manufacturers:

1. Square D.

2. ABB.

3. Eaton.

B. Product Description: NEMA KS 1, Type HD heavy-duty with externally operable handle interlocked to prevent opening front cover with switch in ON position enclosed load interrupter knife switch. Handle lockable in OFF position.

C. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel or brushed stainless steel.

1. Interior Dry Locations: Type 12.

2. Exterior Locations: Type 4X stainless steel.

3. Wet Locations: Type 4X stainless steel.

4. Hazardous Locations: Type 7.

D. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.

E. Furnish switches with entirely copper current carrying parts.

2.02. SWITCH RATINGS

A. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.

B. Short Circuit Current Rating: UL listed for 10,000 rms symmetrical amperes.

PART 3 EXECUTION

3.01. EXISTING WORK

A. Disconnect and remove abandoned enclosed switches.

B. Maintain access to existing enclosed switches and other installations remaining active and requiring access. Modify installation or provide access panel.

C. Clean and repair existing enclosed switches to remain or to be reinstalled.

3.02. INSTALLATION

A. Install enclosed switches plumb. Provide supports in accordance with Section 16070.

B. Height: 5 feet to operating handle.

C. Install fuses for fusible disconnect switches as required.

D. Install engraved plastic nameplates in accordance with Section 16075.

E. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.03. FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.5.

END OF SECTION

SECTION 16413

ENCLOSED TRANSFER SWITCHES

PART 1 GENERAL

1.01. SUMMARY

A. Automatic transfer switches with delayed transition, no bypass. Sizes and configurations as shown on the Drawings.

1.02. REFERENCES

A. NFPA 70 - National Electrical Code.

B. NEMA ICS 1 - General Standards for Industrial Control and Systems.

C. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers, and Assemblies.

D. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

1.03. QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 20 years documented experience and with service facilities within 50 miles of Project.

B. Supplier: Authorized distributor of specified manufacturer with minimum 10 years documented experience.

1.04. DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to internal components, enclosure and finish.

1.05. FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

1.06. MAINTENANCE SERVICE

A. Furnish service and maintenance of transfer switch for one year from Date of Substantial Completion.

1.07. MAINTENANCE MATERIALS

A. Provide two of each special tool required for maintenance.

PART 2 PRODUCTS

2.01. MANUFACTURERS

A. ASCO, Model 7000 Series 7ADTS.

2.02. AUTOMATIC TRANSFER SWITCH

A. Description: NEMA ICS 10, automatic transfer switch.

B. Configuration: electrically-operated, mechanically-held transfer switch.,

C. The electrical operator shall be a single-solenoid mechanism, momentarily energized. Main operators which include overcurrent disconnect devices will not be accepted.

D. The switch shall be mechanically interlocked to ensure only one of two possible positions, normal or emergency.

E. The switch shall be positively locked and unaffected by momentary outages so that contact pressure is maintained at a constant value and temperature rise at the contacts is minimized for maximum reliability and operating life.

F. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented, blow-on construction for high withstand current capability and be protected by separate arcing contacts.

G. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. A manual operating handle shall be provided for maintenance purposes. The handle shall permit the operator to manually stop the contacts at any point throughout their entire travel to inspect and service the contacts when required.

H. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof which are not intended for continuous duty, repetitive switching or transfer between two active power sources are not acceptable.

I. Where neutral conductors are to be solidly connected as shown on the plans, a neutral conductor terminal plate with fully-rated AL-CU pressure connectors shall be provided.

2.03. SERVICE CONDITIONS

A. Service Conditions: NEMA ICS.

B. Temperature: 85 degrees F

C. Altitude: 500 feet

2.04. RATINGS

A. Voltage: 480/277 volts, three phase, four wire, 60 Hz.

B. Switched Poles: 4

C. Load Inrush Rating: Combination load.

D. Continuous Rating: 1,200 amperes.

E. Interrupting Capacity: 100 percent of continuous rating.

F. Withstand Current Rating: The ATS shall be rated to close on and withstand the available rms symmetrical short circuit current at the ATS terminals with the type of overcurrent protection shown on the plans.

2.05. PRODUCT OPTIONS AND FEATURES

A. Indicating led (light emitting diode) lights: Mount in cover of enclosure, one to indicate when the ATS is connected to normal source (green), one to indicate when the ATS is connected to emergency source (red), one to indicate when the normal source is available (green) and one to indicate when the emergency source is available (red).

B. Automatic transfer switches shall include a keyed selector switch to select starting the permanent stationary generator or a portable generator. Accessory 6GK.

C. Test Switch: Mount in cover of enclosure to simulate failure of normal source.

D. Return to Normal Switch: Mount in cover of enclosure to initiate manual transfer from alternate to normal source, to bypass time delay.

E. Transfer Switch Auxiliary contacts: Contacts rated 10 amps, 480VAC shall be provided consisting of one contact, closed when the ATS is connected to normal source and one contact closed, when the ATS is connected to emergency source.

F. Normal Source Monitor: The voltage of each phase of the normal source shall be monitored, with pickup adjustable from 85% to 100% and dropout adjustable from 75% to 98% of pickup setting.

G. Alternate Source Monitor: Single-phase voltage sensing of the emergency source shall be provided, with a pickup voltage adjustable from 85% to 100% and frequency sensing with pickup adjustable from 90% to 100%.

H. In-Phase Monitor.

I. Switched Neutral.

J. Provide 3-phase voltage monitor for the normal and emergency sources (accessories 18B/G) with pair of normally-open and normally closed dry-contacts for alarm monitoring.

2.06. AUTOMATIC SEQUENCE OF OPERATION

A. Initiate Time Delay to Start Alternate Source Engine Generator: Upon initiation by normal source monitor.

B. Time Delay To Start Alternate Source Engine Generator: 0 to 6 seconds, adjustable.

C. Initiate Transfer Load to Alternate Source: Upon initiation by normal source monitor and permission by alternate source monitor.

D. Time Delay Before Transfer to Alternate Power Source: 0 to 5 minutes adjustable.

E. Initiate Retransfer Load to Normal Source: Upon permission by normal source monitor.

F. Time Delay Before Transfer to Normal Power: 0 to 30 minutes, adjustable; bypass time delay in event of alternate source failure.

G. Time Delay Before Engine Shut Down: 0 to 60 minutes, adjustable, of unloaded operation.

H. Repetitive accuracy of all settings shall be +/- 2% or better over an operating temperature range of -20°C to 70°C. Voltage and frequency settings shall be fully field adjustable in 1% increments over the whole range without the use of tools, meters or power supplies.

2.07. ENCLOSURE

A. Enclosure: ICS 6, Type 12.

B. Finish: Manufacturer's standard gray enamel.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify that surface is suitable for transfer switch installation.

3.02. INSTALLATION

A. Install transfer switches in accordance with manufacturer's instructions.

B. Provide engraved plastic nameplates under the provisions of Section 16075.

3.03. MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems.

3.04. DEMONSTRATION

A. Demonstrate operation of transfer switch normal and emergency modes.

3.05. TESTS AND CERTIFICATION

A. The manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards, and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.

B. The manufacturer shall be certified to the ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001.

3.06. SERVICE REPRESENTATION

A. The ATS manufacturer shall maintain a local service center within a 50 mile radius of the job location. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.

B. The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.

END OF SECTION

SECTION 16442

PANELBOARDS

PART 1 GENERAL

1.01. SUMMARY

A. Section includes branch circuit panelboards LP-UH and LP-TM.

B. Related Sections:

1. Section 16060 - Grounding and Bonding.

2. Section 16075 - Electrical Identification

1.02. REFERENCES

A. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (published by the International Electrical Testing Association).

B. NECA Standard of Installation (published by the National Electrical Contractors Association).

C. Institute of Electrical and Electronics Engineers:

1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

D. National Electrical Manufacturers Association:

1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.

2. NEMA FU 1 - Low Voltage Cartridge Fuses.

3. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.

4. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.

5. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

6. NEMA PB 1 - Panelboards.

7. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

E. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

F. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.

G. Underwriters Laboratories Inc.:

1. UL 67 - Safety for Panelboards.

2. UL 1283 - Electromagnetic Interference Filters.

3. UL 1449 - Transient Voltage Surge Suppressors.

1.03. SUBMITTALS

A. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

B. Product Data: Submit catalog data showing specified features of standard products.

1.04. SUBMITTALS FOR INFORMATION

A. Submit manufacturer’s installation instructions. Indicate application conditions and limitations of use.

1.05. CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.

B. Operation and Maintenance Data: Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.06. QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.07. MAINTENANCE MATERIALS

A. Furnish two of each panelboard key. Panelboards keyed alike to Owner’s current keying system.

PART 2 PRODUCTS

2.01. BRANCH CIRCUIT PANELBOARDS

A. Manufacturers:

1. Square D, NQOD series. Design Basis.

2. ABB.

3. Eaton.

B. Product Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.

C. Panelboard Bus: Copper, current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard.

D. For non-linear load applications subject to harmonics furnish 200 percent rated, plated copper, solid neutral.

E. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 240 volt panelboards; 22,000 amperes rms symmetrical for 480 volt panelboards, or as indicated on Drawings.

F. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter or arc fault circuit breakers as indicated on Drawings. Do not use tandem circuit breakers.

G. Current Limiting Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size NEMA FU 1, Class RK-5 fuse.

H. Enclosure: NEMA PB 1, Type 12.

I. Cabinet Box: 6 inches deep, 20 inches wide for 240 volt and less panelboards, 20 inches wide for 480 volt panelboards.

J. Cabinet Front: Surface cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock keyed alike. Front cover of enclosure to bolt onto backbox and shall have an exposed piano hinge separate from circuit breaker cover. To open wiring compartment, unbolt only designated bolts, the remainder to remain and open cover by hinges (door-in-door type). Finish in manufacturer's standard gray enamel.

PART 3 EXECUTION

3.01. EXISTING WORK

A. Disconnect abandoned panelboards. Remove abandoned panelboards.

B. Maintain access to existing panelboard remaining active and requiring access. Modify installation or provide access panel.

C. Clean and repair existing panelboards to remain or to be reinstalled.

3.02. INSTALLATION

A. Install panelboards and load centers in accordance with NEMA PB 1.1.

B. Install panelboards and load centers plumb.

C. Install recessed panelboards and load centers flush with wall finishes.

D. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.

E. Install filler plates for unused spaces in panelboards.

F. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes to balance phase loads.

G. Install engraved plastic nameplates in accordance with Section 16075.

H. Install spare conduits out of each recessed panelboard to accessible location. Minimum spare conduits: 5 empty 1 inch. Identify each as SPARE.

I. Ground and bond panelboard enclosure according to Section 16060. Connect equipment ground bars of panels in accordance with NFPA 70.

3.03. FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.

C. Perform switch inspections and tests listed in NETA ATS, Section 7.5.

D. Perform controller inspections and tests listed in NETA ATS, Section 7.16.1.

3.04. ADJUSTING

A. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION

SECTION 16461

DRY TYPE TRANSFORMERS

PART 1 GENERAL

1.01. SUMMARY

A. Section includes furnishing and installing two-winding transformers.

1.02. REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA ST 1 - Specialty Transformers (Except General Purpose Type).

2. NEMA ST 20 - Dry Type Transformers for General Applications.

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

2. NFPA 70 - National Electrical Code.

1.03. SUBMITTALS FOR REVIEW

A. Product Data: Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.

1.04. SUBMITTALS FOR INFORMATION

A. Test Reports: Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.

B. Submit manufacturer’s installation instructions. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.05. CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of transformers.

1.06. QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.

1.07. REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70.

B. Products: Listed and classified by Underwriters Laboratories, Inc., as suitable for the purpose specified and indicated.

C. Department of Energy – DOE 2016 distribution transformer efficiency.

1.08. DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01. TWO-WINDING TRANSFORMERS

A. Manufacturers:

1. Square D.

2. ABB.

3. ACME Transformers.

B. Product Description: NEMA ST 20, factory-assembled, air-cooled, dry type transformers, ratings as indicated on Drawings.

C. Primary Voltage: 480 volts, 3 phase, 3 wire.

D. Secondary Voltage: 208Y/120 volts, 3 phase, 4 wire.

E. Insulation system and average winding temperature rise for rated kVA as follows:

1. 1-15 kVA: Class 185 with 115 degrees C rise.

2. 16-500 kVA: Class 220 with 150 degrees C rise.

F. Case temperature: Do not exceed 50 degrees C rise above ambient at warmest point at full load.

G. Winding Taps:

1. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.

2. Transformers 15 kVA and Larger: NEMA ST 20.

H. Sound Levels: NEMA ST 20. Maximum sound levels are as follows for 150°C rise:

1. 0-9 kVA: 40 dB.

2. 10-50 kVA: 45 dB.

3. 51-150 kVA: 50 dB.

4. 151-300 kVA: 55 dB.

5. 301-500 kVA: 60 dB.

I. Basic Impulse Level: 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.

J. Ground core and coil assembly to enclosure by means of visible flexible copper grounding strap.

K. Mounting:

1. 1-15 kVA: Suitable for wall mounting.

2. 16-75 kVA: Suitable for floor or trapeze mounting.

3. Larger than 75 kVA: Suitable for floor mounting.

L. Coil Conductors: Continuous copper windings with terminations brazed or welded.

M. Enclosure: NEMA ST 20, Type 2 ventilated. Furnish lifting eyes or brackets.

N. Isolate core and coil from enclosure using vibration-absorbing mounts.

O. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.02. SOURCE QUALITY CONTROL

A. Production test each unit according to NEMA ST20.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify mounting supports are properly sized and located including concealed bracing in walls.

3.02. EXISTING WORK

A. Disconnect and remove abandoned transformers.

B. Maintain access and adequate ventilation to existing transformers and other installations remaining active and requiring access and ventilation. Modify installation or provide access panel or ventilation grilles.

C. Clean and repair existing transformers to remain or to be reinstalled.

3.03. INSTALLATION

A. Set transformer plumb and level.

B. Use flexible conduit, in accordance with Section 16130, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

C. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by manufacturer.

D. Mount floor-mounted transformers on vibration isolating pads suitable for isolating transformer noise from building structure.

E. Mount trapeze-mounted transformers as indicated on Drawings.

F. Provide seismic restraints.

G. Install grounding and bonding in accordance with Section 16060.

3.04. FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.2.1.

3.05. ADJUSTING

A. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION

SECTION 16480

VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

1.01. DESCRIPTION

A. This Section covers the requirements for variable frequency drives (VFDs) for the pumping system provided by the Contractor. Eight (8) VFDs for the 150 HP vertical centrifugal pumps shall be furnished and mounted by the Contractor at the Union Hill and Tallman Pump Stations. The specified motor is 150 HP, 1800 RPM, 168 FLA, 480V at Union Hill Pump Station and 150 HP, 900 RPM, 187 FLA at Tallman Pump Station. The VFDs shall be provided as a packaged system with the vertical centrifugal pumps and the main pump control panel to ensure compatibility.

B. The Contractor shall furnish, install, terminate, and test all required conduit and wiring for power, controls, and field mounted devices.

C. Provide the hereinafter specified equipment as part of the systems called for in the Specifications and the Contract Drawings.

1.02. REFERENCES

A. The latest revisions of the following standards and specifications are incorporated herein by reference and form a part of this Specification to the extent that sections or portions of section are applicable hereto.

1. National Electric Code (N.E.C.)

2. Underwriter’s Laboratories, Inc. (U.L.) - U.L. 508.

3. National Electrical Manufacturers Association (NEMA)

   a. NEMA - 1C-1

   b. NEMA ICS 3.1

   c. NEMA 250

4. American National Standards Institute (ANSI)

5. Standards for Industrial Control (J.I.C.)

6. Institute for Electronic and Electrical Engineering (IEEE) - IEEE 519.

1.03. SYSTEM DESCRIPTION

A. Performance Requirements

1. Manufacturer shall provide performance affidavits for each drive or system of drives in accordance with Section 01640.

B. Harmonic Filters

1. Manufacturer shall provide harmonic filters integral to the VFD for each drive which shall reduce harmonic distortion below levels specified in IEEE STD. 519.

2. Manufacturer shall provide dedicated low-harmonic filters within the VFD enclosure. An LCL filter, line side converter and motor side inverter shall be provided.

3. Manufacturer shall submit design calculations with the VFD shop drawing submittal proving compliance with IEEE STD. 519. Contractor shall obtain from the plant's existing arc flash study for service and transformer data required for harmonic analysis.

4. The Contractor shall coordinate (with the Engineer and Owner) the location and installation of harmonic filters external to supplied VFDs, should they be required as determined by the manufacturer. The Contractor shall provide all interconnecting conduit and wiring between VFDs and these external harmonic filters.

1.04. SUBMITTALS

A. Submittals shall be made in accordance with Sections 01300, and 16010.

B. Submit performance affidavit and operation and maintenance manuals as per Section 01640.

C. Submit harmonic analysis (calculations) and electrical utility approval of proposed VFD installation.

D. Submit written description of sequence of operation for each set of VFDs.

E. Submit dimensional data for each VFD. Include as a minimum: height, width, depth, distance from bottom of enclosure to center line of disconnect handle, conduit openings, size and location of cooling vents.

F. Submit drawings showing interior enclosure layout and panel door layout.

G. Submit elementary diagrams and block diagrams for each VFD system. Indicate how/where remote equipment is wired to each VFD system.

H. Submit manufacturer's literature containing information needed to prove conformance with these Specifications.

I. Seismic considerations: the Building Code of the State of New York, latest edition (including amendments) shall be in effect. Submit shop drawings for all electrical supports and anchors that include seismic restraint calculations and details as required to meet earthquake design data indicated on the structural drawings. Calculations and details, if required, shall be designed and stamped by a New York registered professional engineer retained by the Contractor.

1.05. QUALIFICATIONS

A. Manufacturer - Company specializing in manufacturing the products specified in this Section with minimum three years documented experience.

B. The VFD manufacturer shall have service facilities within 100 miles of the site.

1.06. DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle equipment to site.

B. Deliver in 48-inch maximum width shipping splits, individually wrapped for protection and mounted on shipping skids.

C. Store in a clean dry space. Maintain factory wrapping or provide a heavy canvas or heavy plastic to protect units from dirt, water, debris, and traffic. The Contractor shall replace any equipment damaged during shipping, handling, or storage.

1.07. SPARE PARTS

A. The following spare parts shall be furnished for each size VFD provided.

1. Six (6) of each type of control fuse used.

2. Six (6) of each type of power fuse used.

3. One spare of each type of door mounted keypad.

4. One complete power semiconductor assembly (VFD) for each size supplied.

5. All other spare parts normally recommended.

1.08. WARRANTY

A. The VFD Product Warranty shall be 30 months for start-up performed by an authorized factory-trained provider or 36 months (3 years) from the date of manufacture, whichever occurs first. Any warranty claim shall include all parts, labor, travel time and expenses.

PART 2 PRODUCTS

2.01. MANUFACTURERS

A. Whenever possible, all VFDs provided shall be by the same manufacturer.

1. Design Basis – ABB ACQ580 ultra low-harmonic series, enclosed drive controllers.

2. Rockwell Automation – 755TL ultra low-harmonic series, enclosed drive controllers.

3. Or approved equal.

B. All materials and equipment furnished shall be current products of manufacturers regularly engaged in the manufacturer of VFD and for which replacement parts are available.

2.02. PULSE-WIDTH MODULATED VARIABLE FREQUENCY DRIVE

A. General

1. The Contractor shall furnish and install the complete variable frequency drive (VFD) system(s) described in this specification and as shown on the Contract Drawings.

2. Drives shall be microprocessor controlled with digital display and programming/status key pad.

3. The VFDs shall be rated for the full horsepower and full load amperes and rpm of the equipment as indicated. Motor service factors shall be minimum 1.0, unless otherwise specified in respective equipment Sections. VFDs shall be specifically designed to provide continuous speed adjustment of three phase, inverter duty, NEMA design 'B' squirrel cage motors.

   The VFD applications shall be for the systems listed in Table 16480-1 at the end of this Section.

4. Complete configured VFD system shall be U.L. listed per U.L. 508.

5. All VFDs shall be provided by the pump manufacturer.

B. The VFD shall be solid state, with a Pulse Width Modulated (PWM) output. The VFD shall be a Sensor-less Vector AC to AC converter utilizing the latest Insulated Gate Bipolar Transistor (IGBT) technology. The VFD shall employ a Sensor-less Vector inner loop torque control strategy that mathematically determines motor torque and flux. The VFD must also provide an optional operational mode for V/Hz Operation.

C. Ratings

1. The VFD shall be rated to operate from 3-phase power at one of the following voltage ranges. (208-240), (380-480), (500-600) VAC +10%/-15%, 48Hz to 63Hz. The VFD shall employ a full wave rectifier to prevent input line notching and operate at a fundamental (displacement) input power factor of 0.98 at all speeds and nominal load. The ACQ580 standard VFD efficiency shall be 98% or better at full speed and load.

2. VFDs (208-240Vac) 1-100 Hp, (380-480Vac) 1-350 Hp, (500-600Vac) 2-250 Hp shall have internal chokes (reactors) to reduce input current harmonic content, provide protection from power line transients such as utility power factor correction capacitor switching transients and reduce RFI emissions.

   An internally mounted AC line reactor shall be provided, on (380-480Vac) 400-700 Hp, ACQ580 VFDs to reduce input current harmonic content, provide protection from power line transients such as utility power factor correction capacitor switching transients and reduce RFI emissions.

3. The overvoltage trip level shall be a minimum of 30% over nominal, and the under-voltage trip level shall be a minimum 35% under the nominal voltage.

4. Normal Duty/Variable Torque output voltage and current ratings shall match the adjustable frequency operating requirements of a standard AC induction, synchronous reluctance (SynRM) or permanent magnet (PM) motors in water and wastewater applications. The short-term normal duty overload current capacity shall be 110% of rated current for one (1) minute out of ten (10) minutes.

5. Heavy Duty/Constant Torque output voltage and current ratings shall match the adjustable frequency operating requirements a standard AC induction, synchronous reluctance (SynRM) or permanent magnet (PM) motors in water and wastewater applications. The short term heavy duty overload current capacity shall be 150% of rated current for one (1) minute out of ten (10) minutes and peak overload capacity shall be 180% for two (2) seconds out of each minute with an instantaneous overcurrent trip at 350% or higher.

6. Output frequency shall be adjustable between 0Hz and 500Hz forward or reversing. Operation above motor nameplate shall require programming changes to prevent inadvertent high-speed operation.

7. The VFD shall be furnished in an Open Chassis (IP00) , UL Type 1 (NEMA 1) or UL Type 12 (NEMA 12) listed enclosure rated as specified for operation at ambient temperatures between -15°C and 40°C at an altitude not exceeding 3300 feet, with relative humidity less than 95% and no condensation allowed.

8. The printed circuit boards (PCB) shall be conformal coated to protect from atmospheric contamination by Chemical gasses and Solid particles per IEC 60721-3-3; Chemical gasses Class 3C2 and Solid particles Class 3S2.

2.03 MOTOR CONTROL

A. The VFD shall be capable of controlling an induction motor, permanent magnet motor and synchronous reluctance motors as standard. Have a maximum allowed motor cable length 1000 feet (300 meters). The VFD shall commission an induction motor, permanent magnet motor and synchronous reluctance motor with the motor nameplate values only, without the need to get the motor values from other sources.

B. Scalar and vector control modes shall be supported and there shall be independent control chains and parameters for both of the motor control modes.

C. The overload rating of the VFD shall be 110 % of its rated normal duty current for 1 minute every 10 minutes and with a minimum of 130 % for 2 seconds every 1 minute. Overload ability shall be available at all times - not only at start.

D. The VFD shall be capable of sensing the loss of load (broken belt/broken coupling/dry pump) and signal the loss of load condition. The drive shall be possible to be programmed to signal this condition via a control panel warning, relay output and/or over the serial communications.

E. Relay outputs shall include programmable for on/off time delays that will allow for drive acceleration or deceleration to and from zero speed, without signaling a false underload condition.

F. It shall be possible to disconnect a motor running full speed by opening an optional contactor between motor and VFD without causing any damage to the VFD.

G. The VFD shall include a standard embedded functional safety feature Safe Torque Off, (STO), to make the motor mechanically safe.

H. The VFD shall include an energy optimization circuit (flux optimization) that will automatically reduce applied motor voltage to the motor to reduce energy consumption by up to 10% and lower audible motor noise.

I. The VFD shall be capable of starting into a spinning load (forward or reverse) up to full speed and accelerate or decelerate to a set-point (flying start) without tripping or component damage.

J. The VFD shall restart after a power loss without the need to resend the start command. This feature shall be there regardless of the control source, control panel, I/O or fieldbus.

K. Flux braking shall be available, where the VFD controls the motor to dissipate the extra rotary energy as heat whenever braking is required. It shall be possible to use this flux braking feature to decelerate the motor from one speed to another – not only for stopping the motor.

L. Power-Loss-Ride-Through shall be programmable. If the incoming supply voltage is cut off, the VFD continues to operate using the kinetic energy of the rotating motor. The drive continues to be operational as long as the motor rotates and generates energy.

M. The VFD shall include a switching frequency control function. This adjusts the switching or carrier frequency, based on actual VFD temperature, and allows the highest carrier frequency without de-rating the VFD or operating at high carrier frequency only at low speeds (temperature fold-back). It shall be possible to set a minimum and a reference switching frequency.

N. The VFD shall include a noise smoothing function, which distributes the acoustic motor noise over a range of frequencies instead of a single tonal frequency resulting in lower peak noise intensity.

O. The VFD shall have three (3) programmable critical frequency or critical speed lockout ranges to prevent the VFD from operating the load continuously on an undesirable speed range (skip frequencies)

2.04 STANDARD CONTROL HARDWARE FEATURES – ADJUSTABLE BY THE USER

A. General I/O

1. All I/O terminals shall be color coded to simplify wiring and troubleshooting and shall have a special mode for testing I/O and the drive configuration without being connected to equipment.

2. All I/O shall be accessible (monitor and control) for fieldbus protocols (pass-through I/O).
3. It shall be possible to monitor status of the I/O from VFDs control panel
   a. ANALOG I/O

4. The VFD shall have at least two (2) programmable analog inputs. Both inputs shall accept current (0 to 20 mA or 4 to 20mA) or voltage (0 to 10 VDC) signals. The signal type selection, voltage or current, shall be made via VFD user interface. DIP-switches or jumpers are not allowed for input type programming. Analog Input shall have an inaccuracy of ≤1 % of full scale in both current and voltage modes.

5. The analog inputs shall be programmable to be used as: speed reference, frequency reference, pressure monitor, PID loop controller's set-point reference or signal feedback, or other defined inputs.

6. If the analog input reference (4 to 20 mA or 2 to10 VDC) is lost, the VFD shall give the user the option of: (1) stopping and displaying a fault; (2) running at a programmable preset speed and displaying an alarm; (3) hold the VFD speed based on the last good reference received and displaying an alarm. The drive shall be programmable to signal this condition via a control panel warning, relay output and/or over the serial communication bus.

7. The VFD shall have at least two (2) programmable analog outputs (0 to 20 mA or 4 to 20 mA) out of which one shall be software configurable to be either voltage (0 to 10 VDC) or current output. Analog Output shall have an inaccuracy of ≤1 % of full scale in both current and voltage modes.

8. The analog outputs shall be programmable to give an output signal proportional to frequency, motor speed, output voltage, output current, motor torque, motor power, DC bus voltage, active reference, or other defined data.

B. DIGITAL I/O

1. The VFD shall have at least six (6) programmable digital inputs (24 VAC and 12 to 24 VDC, PNP or 5 pcs NPN) to connect to external devices, as follows:

a. All inputs can be configurable for PTC sensors.

b. There shall be a programmable run permissive circuit.

c. Up to four (4) programmable free text interlock inputs shall be available.

d. The VFD shall have at least one digital input which can be configured to receive a pulse signal up to 16 kHz.

C. Relay I/O

1. The VFD shall have at least three (3) programmable digital Form-C relay (changeover) outputs. The relays shall include programmable on and off delay times and adjustable hysteresis.

D. I/O Optional Extension Modules

1. The following I/O option modules shall be available:

a. Relay Extension module with two relay outputs and one digital output, with an external input 24 volt to maintain power and control of module.

b. PTC input module for up to 6 PTC sensors with an external input 24 volt to maintain power and control of module and is capable of triggering the STO circuitry of the VFD.

c. Digital input option module to provide additional 6 digital inputs which can be operated with 115 VAC or 230 VAC voltage.

2.05 SOFTWARE FEATURES

A. Pump specific features:

1. The VFD shall have specific pump control functionality to control up to six pumps with one VFD to allow distribution of pump usage in a multiple pump system.

2. The VFD shall have multi-pump functionality with an intelligent master/follower configuration for controlling up to eight parallel pumps equipped with own VFD without additional devices:

a. The VFD shall have a parameter synchronization feature to broadcast PID, Multi-pump and Analog Input parameters to ensure system parametrization is equal in the parallel VFDs

b. The VFD shall have specific functionality to start and stop the pumps based on the required pumping capacity. In order to balance the operating time of the pumps, the VFD shall have the capability to change the order in which the pumps are started and stopped.

c. The VFD shall have the capability to give priorities for parallel pumps in the system to enable the most efficient pumps to be operated the most.

d. The VFD shall have the capability to set a maximum stationary time to ensure all pumps get exercised regularly, regardless of their priorities.

e. The VFD shall have the capability to control across-the-line pumps instead of parallel VFDs, in order to resolve the system demand.

3. The VFD shall have a level control function with operation modes for optimal tank filling or emptying supporting up to eight parallel pumps.

   a. User–programmable start level shall indicate the point at which the pump will start.

   b. The pump(s) shall operate in user-programmable “efficient speed”.

   c. If the level keeps raising, more pumps will be started based on unique start levels.

   d. There shall be a possibility to connect high- and low- level limit switches, which will trigger either full speed pumping or pump stop, depending if the application is for filling or emptying a tank

4. The VFD shall have the ability to calculate the flow based on the measured pressure difference (using pressure sensors) or the power curve of the pump (sensor-less).

   a. There shall be a multiplier parameter to enable correction for the calculation.

   b. There shall be a specific energy parameter to measure actual flow per input power ratio. The motor speed can be adjusted to locate the most economical pumping point.

5. The VFD shall have two additional ramps for quick acceleration and two additional for deceleration in order to reduce wear of the mechanical parts in submersible pumps.

6. The VFD shall have soft pipe filling function with flexible user parameter settings to protect the system. There shall be a configurable pipe fill time to ensure the setpoint is reached within a desired time.

7. The VFD shall have a specific “Pump cleaning” functionality, based on a series of rapid reverse and forward rotation of the impeller, to prevent pump and pipe clogging.

   a. The VFD shall have the cleaning cycle counter and user-programmable cleaning count time to give a warning and indicate the need for manual inspection.

   b. The cleaning function shall consist of forced stopping, reverse and forward rotations to allow debris to be removed from the impeller.

   c. There shall be a cleaning cycle status visible on the control panel screen when the cleaning function is active for monitoring the cleaning progress.

   d. The VFD shall resume normal operation after the cleaning cycle is complete.

8. The VFD shall have a programmable Sleep functionality for PID control in pumping systems to stop the pump during low demand.

    a. The VFD shall have a specific “Sleep Boost” functionality to minimize the amount of unnecessary pump starts and stops during periods of low demand. The sleep boost function is used to boost the pressure or water level up before the pump shuts down in order to extend the pumps sleeping time.

9. The VFD shall support a torque boost function for applications where boosting of the torque is required for initial starting of the pump.

B. PID Control

1. The VFD shall have a minimum of two independent process PID controllers as standard, allowing pressure or flow signals to be connected to the VFD, using the microprocessor in the VFD for the closed loop control.

    a. The VFD shall have 250 mA of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by other suppliers.

    b. The loop controller setpoint shall be adjustable from the VFDs control panel, analog inputs, or over the serial communications bus.

    c. The VFD shall have a minimum of four constant setpoints available for each loop controller.

    d. The setpoint shall be possible to be set and displayed in engineering units. Using only percentage as setting and display unit is not acceptable.

    e. There shall be two parameter sets for the first PID loop controller. Switching between the sets shall be possible via digital inputs, timed function, and serial communications or from the control panel.

2. All setpoints, process variables, etc. shall be accessible from the serial communication bus.

3. The VFD shall have the ability to calculate air or water flow from pressure difference. There shall be the possibility to use a differential pressure transducer or two separate pressure transducers. The control panel shall be able to display the flow in engineering units.

4. PID controller shall be standard in the VFD, allowing an analog input signals to be connected to the VFD for the closed loop control. The VFD shall have 250 mA of 24 VDC power to power an external transmitter supplied by others. The loop controller set-point shall be adjustable from the VFD control panel, analog inputs, or over field bus. The set-point shall be set and displayed in engineering units.

C. Function block programming

1. The VFD shall provide a PLC-like programming capability as standard.

2. It shall be possible to use different kinds of arithmetic, logical, selection, comparison, and operation function blocks to monitor and control the VFD, functions, inputs, outputs, and variables.

3. There shall be a possibility to run different kinds of function block programs in different states and to set the criteria, when to change the state.

D. Timed functions

1. A real-time clock and calendar shall be available as standard for giving true time and date information to fault event history. The real-time clock shall have a minimum of 10 years power-off back-up without optional components. Back-up battery shall be replaceable without opening the VFD enclosure

2. A real-time clock shall be possible to use with timed functions, which shall allow controlling the VFD and its functions based on: time of the day, day of the week, seasons of the year, holiday periods and holiday dates and special working periods and working days

3. Timed functions shall be possible to use for: starting and stopping the VFD, for selecting the speed reference, for selecting the PID loop controller's set-point, for controlling the relay outputs, for selection the control location, for giving the run permissive or interlock signal to the VFD, etc.

4. There shall be the ability to temporarily override the time-controlled start and start the and/or its functions regardless of the time of the day, day of the week, season of the year, holiday, or workday.

E. Fault Logger: A fault logger shall accommodate seven diagnostic values together with a date and time stamp.

F. Built in Energy Calculators: There shall be built-in counters for calculating energy savings achieved with the VFD.

1. Used and saved energy

2. CO2 reduction

3. Saved money

4. Programmable kW rate

G. Pre-Set Speeds: There shall be a minimum of seven programmable pre-set speeds or frequencies.

H. Operating Values: All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three operating values from the list below shall be capable of being displayed at all times. Engineering units shall be freely configurable for the user to display.

1. Output frequency

2. Motor speed (RPM, %, or engineering units)

3. Motor current

4. Calculated motor torque

5. Calculated motor power (kW)

6. DC bus voltage

7. Output voltage

8. Energy Consumption

I. Underload and overload curves shall be user definable.

J. Independently adjustable acceleration and deceleration ramps with 1 to 1800 seconds adjustable time ramps. There shall be a possibility to use start delay before acceleration to ensure that all start conditions have been fulfilled.

K. Changed parameters list shall be available in order to assist commissioning and troubleshooting.

L. The VFD shall include pass code protection against unauthorized parameter changes. The pass code and the protection level shall be possible to be defined by the user.

M. The VFD shall have ability to use any internal parameter value as input for any other parameter.

N. The VFD shall have the capability to fault or to show warning when triggered from external sources.

2.06 PROTECTIONS

A. The following protection functions shall be available:

1. Dry pump Protection (prevents the pump from running dry, protecting the pumps bearings and shaft seal from damage when there is no water in the pump).

2. Overvoltage and under-voltage controller.

3. Ground Fault (Earth-leakage) supervision.

4. Motor short-circuit protection.

5. Output and input switch supervision.

6. Overcurrent protection.

7. Phase-loss detection (both motor & line).

a. The VFD shall have the capability to continue running at a reduced output current when an input phase-loss is detected.

b. The VFD shall have the capability to detect an open circuit on the output of the VFD without the requirement to have the VFD modulating.

8. Underload and overload supervision.

9. Freely configurable supervisions for any parameter or signal to trigger an action.

10. Communication loss functionality to ensure uninterrupted operation.

a. The VFD shall have the capability to change the control location from PLC to another external location identified by user, e.g. VFDs embedded PID/loop controller and change back when communication is recovered.

11. The VFD shall have pump protection functions for flow and pressure to avoid damages of the pump and for leakage detection.

a. Inlet protection for avoid dry run, cavitation, and blocked pipe.

b. Outlet protection for avoid high pressure and leakages.

c. Stall protection for avoid running locked pump.

12. The VFD shall have the capability to detect cavitation within the pump without need for external devices

a. There shall be a possibility to enunciate a warning only, fault the VFD, or control the output frequency of the VFD to try and eliminate the cavitation.

b. There shall be user-programmable values for the cavitation control feature, to allow application specific response when controlling the output frequency.

2.07 USER INTERFACES

A. Detachable control panel

1. The control panel shall be detachable in all types of VFD protection classes and/or enclosures, without tools to allow easy commissioning and programming of multiple VFDs.

2. The control panel shall include a backlit LCD.

3. The control panel shall have a real-time clock with battery backup for adding time stamps to events, as well as for use with timer functions.

4. The control panel shall provide a clear, interactive, context sensitive menu-based user interface to make it easy to adjust the settings of the VFD.

5. The display shall be in complete words, in a language selectable by the user, for programming and fault diagnostics (alphanumeric fault codes are not acceptable).

6. The control panel shall provide interactive assistants (wizards) to help to commission and use the VFD.

7. A dedicated “Help” button shall be available on the control panel. The Help button shall provide context sensitive assistance for programming and troubleshooting.

8. The control panel shall provide an easy to use I/O menu, where the user can see the status and function of all the analog and digital inputs and outputs.

9. The control panel shall have a menu, which contains diagnostic data about the VFD operation. The data shall include data about active faults, warnings, and events. In addition, the data shall contain a summary of VFD active control sources.

10. There shall be an editable home-view in the control panel to allow different customer specific configurations.

a. A minimum of three operating values shall be capable of being displayed at all times.

1) All applicable operating values shall be capable of being displayed in engineering (user) units.

2) Engineering units shall be freely configurable for the user to display.

11. The control panel shall include Hand-Off-Auto selections and manual speed control.

a. The VFD shall incorporate “bump-less transfer” of speed reference when switching between “Auto” and “Hand” modes.

b. It shall be possible to disable the Hand and Off buttons of the control panel.

c. As a safety feature, the control panel's Hand and Off buttons shall have clear symbols to allow non-English speaking people to understand the meaning of the buttons. English text only is not acceptable in the Hand and Off button marking.

12. There shall be a possibility to reset the VFD from the control panel.

13. The VFD shall have the capability to change the output phase rotation sequence by use of a parameter. This parameter must be independent from, and not affecting, any speed reference or direction input to the VFD.

14. The VFD shall have the capability to run the motor in either direction, forward or reverse. Additionally, the VFD shall allow for forcing the direction in a given direction, regardless of the speed reference or direction input to the VFD.

15. A listing of changed parameters shall be readily available in order to assist with commissioning and troubleshooting.

16. The VFD shall have flexible selections within a parameter. Not only shall the parameter have a list for easy selection, when applicable, but also the ability to choose any other signal/parameter that may not be within the list.

17. The VFD shall include pass code protection against unauthorized parameter changes. The pass code and the protection level shall be possible to be defined by the user.

18. The control panel shall contain at least one back-up of the VFD settings. Back-up information shall be possible to be saved on the control panel both manually and automatically.

19. The control panel shall have the capability to copy VFD settings from one VFD to another VFD, regardless of the VFD power, voltage, or enclosure rating.

20. The control panel shall have an editable "Contact info" that shows up in case of a fault.

21. The user shall be able to take a screen capture snapshot of the display with the control panel and be able to download the screen capture for user's computer for further purposes.

22. The user shall be able to connect a PC tool with a standard USB cable to the control panel in order to set up and control the VFD. It shall be possible to connect the USB cable without using any tools.

23. The VFD shall provide a possibility for wireless communication to allow working outside the arc flash boundary area and/or when there is no easy or safe access to the VFD. Wi-Fi connection is not acceptable because of its cyber security limitations.

    a. For safety reasons, the VFD supplied with wireless communications shall have a local control panel with control buttons regardless of the wireless connection possibility.

B. Serial communications

1. The VFD shall have an EIA-485 (RS-485) port for serial communications as standard.

2. The VFD shall be equipped with built-in fieldbus communication of type Modbus RTU.

3. There shall be following optional protocols available as plug-in and inbuilt options:

    a. Ethernet/IP, Modbus/TCP, CANopen, DeviceNet, PROFIBUS-DP, PROFINET.

    b. Protocols that have a governing authority shall be certified. Use of non-certified protocols is not allowed.

    c. The use of third-party gateways or multiplexers is not acceptable, and all communication modules shall fit inside the enclosure of the VFD.

    d. Serial communication capabilities shall include, but not be limited to: run-stop control, speed set adjustment, proportional/integral/derivative (PID) control adjustments, loop controllers' set-point adjustment, current limit, acceleration/deceleration time adjustments and lock and unlock the control panel.

2.08 PANEL ENCLOSURE

A. Enclosure shall be UL (NEMA) Type 1/UL (NEMA) Type 12. Dual Rated Enclosure

1. Enclosure shall not require side clearance and shall have the ability to be mounted side by side or back to back with 1" clearance.

2. Enclosures shall be no less than 14AWG.

3. Cabling to enclosure shall be specifiable as*, Bottom Entry and Bottom Exit,* for all Floor mounted enclosures

4. Thermostatically Controlled enclosure fans – UL Type 1/12 and are available with N.C./N.O. and changeover contacts.

B. The maximum dimensions of the VFD enclosure shall be 36" wide, 20" deep, 60" high as shown on the drawings.

C. Main Disconnect means shall be Flange mounted design.

1. Flange mounted disconnect to ensure handle position, position of the overcurrent protection device, and provide additional safety when door is open.

2. Circuit Breaker Disconnect

    a. Shall be from the same manufacturer as VFD.

    b. Thermal-magnetic trip unit, panels with HMCPs are not allowed.

3. Fused Disconnect/Disconnect with Fuses

    a. Shall be from the same manufacturer as VFD.

D. Pilot Devices Packages

1. Shall be 30 mm devices.

2. Shall be from the same manufacturer as VFD

3. Indicating lights shall be Push -to-test LED type, with a service life of 25,000h. Pilot light shall be rated IP66.

4. Emergency stop shall be provided.

E. Elapse time meter: shall be non-resettable, sealed, 6 positions, panel mounted, quartz time based device.

F. Input Filters: ABB Standard VFD has 5% equivalent impedance to reduce harmonics and protect VFD from transient voltages.

1. If additional impedance is required. (*Please choose either option below*).

2. Input Reactor 5% impedance line reactor shall be installed to reduce harmonics and protect the drive from harmful voltage spikes.

3. Input Reactor 3% impedance line reactor shall be installed to reduce harmonics and protect the drive from harmful voltage spikes.

G. Output Filters as required per application.

1. Optional: Common Mode shall be available to be installed to reduce common mode voltages on motor windings.

2. Optional: dV/dt filter shall limit motor terminal peak input voltage to 150% of the bus voltage with a wire lead length of 1,000 feet and a carrier frequency of 4 kHz. Windings shall be copper, impregnated with epoxy resin.

3. Optional: Output Load Reactor shall be installed at the output of the drive to reduce voltage distortion at the motor terminals and to minimize insulation stress on the motor.

H. Control panel shall be mounted on front of the enclosure and maintain the integrity of the enclosure. Control panel holder shall be Non-Corrosive.

I. Packaged VFD Solution shall be UL508A rated.

2.09 SYSTEM SPECIFIC CONTROLS AND FEATURES

A. The following control features shall be provided standard on each VFD:

1. Manual-Off-Auto Switch - When this switch is in the “Manual” position, the VFD shall start and stop using pushbuttons located on the VFD enclosure. When this switch is in the “Off” position, the VFD shall be off. When this switch is in the “Auto” position, the VFD shall start and stop via remote contacts from the Main Control Panel (MCP). VFDs shall be capable of both 3 and 4 wire control for remote starting and stopping.

2. Local-Remote Switch - When this switch is in the “Local” position, the speed of the VFD shall be controlled by a potentiometer on the VFD. When this switch is in the “Remote” position, the speed of the VFD shall be capable of being controlled by a remote 4-20mA signal from the MCP.

3. VFD/Pump Sequence of Operation:

a. When the VFD is in “Auto” and “Remote” operation, the VFD shall output an “In Remote” signal to the MCP.

b. Upon a pump start command, the VFD shall start the pump, and ramp up to speed. Speed control shall be as described above.

c. When the VFD receives a pump stop command, the VFD shall ramp the pump speed down to a stop.

d. The VFD shall monitor Motor Winding-temperature, Pump Thrust Bearing-temperature, Intermediate Shaft Bearing Over-temperature, Pump Vibration Switch, and Motor Vibration Switch. When receiving any of these inputs, the respective alarm pilot light shall be lit, the pump shall be stopped, and the common pump/VFD alarm shall be output. A reset pushbutton shall be provided on the door of the VFD to reset the alarm conditions.

e. Emergency Stop – upon activation of an emergency stop input, the pump shall be stopped immediately and inhibited from running until manually reset.

4. Unidirectional operation, programmable acceleration and deceleration, restart into spinning loads. Implementation of the programmable acceleration and deceleration ramping shall be achieved without the programming of devices external to the VFD. The manufacturer shall provide acceleration and deceleration ramp programming as requested by the Engineer during system startup.

5. Full time torque limit, adjustable. Reduces speed to shed load when over current conditions exists.

6. Programmable torque performance from 4 to 60 Hertz. Contractor shall coordinate with manufacturer of each motor controlled by a VFD. Program minimum VFD speed per motor manufacturer's recommendations to avoid overheating the motor.

7. Frequency stability of 0.5 percent for 24 hours with voltage regulation of $\pm$2 percent of maximum rated output voltage.

8. Status indication for the following:

   a. Power on.

   b. Run.

   c. Motor direction.

   d. Overcurrent.

   e. Overtemperature.

   f. High and low phase loss.

   g. Current limit.

   h. Ground fault.

   i. Pump fail.

9. Control power transformer (CPT) for 120 volt AC power for operator devices.

10. Motor slip dependent speed regulation.

11. Minimum one cycle logic power carry-over during loss of power.

12. Programmable automatic restart upon the return of power following a power outage.

13. Automatic restart after fault, minimum three attempts and shutdown with manual reset.

14. Critical frequency rejection or lockout.

15. Programmable preset speeds, minimum of three.

16. Local speed potentiometer and speed indication, configurable in either rpm, percent of full speed, or hertz.

17. Fault log for minimum of last three faults.

18. Isolated process instrument follower input signal of 4-20mA DC, grounded or ungrounded.

19. 4-20mA DC output proportional to 0 to 100 percent speed.

20. Provide auxiliary run output contacts for remote run indication. Run output contacts shall be wired to an interposing relay. The interposing relay shall be provided with a minimum of two normally open and two normally closed contacts, rated for 10 amps at 120 volts.

21. All wiring connections to the VFD shall be made on labeled terminal strips.

22. Common local and remote start/stop contacts, and protective automatic shutdown contacts/switches shall be used by the control circuits of both the VFD and the bypass contactor/starter, if required.

B. The following, manufacturer installed options shall be furnished with the VFDs as specified:

1. AC output contactors.

2. Motor overcurrent relay on VFD and on bypass contactors/starters.

3. Bypass contactors/starters when specified.

C. System Specific Controls and I/O

1. Field-mounted equipment (remote from the VFD enclosure) such as control panels, start/stop pushbuttons, potentiometers, auxiliary contacts on disconnect switches, etc., are shown on the Contract Drawings.

2. Provide the following inputs and outputs on each VFD.

a. Pump start input.

b. Pump running output.

c. Common pump/VFD failure output.

d. In Remote output.

e. Pump speed analog input (4-20mA).

f. Pump speed feedback analog output (4-20mA).

g. Motor Winding High Temperature input.

h. Pump Thrust Bearing High Temperature input.

i. Intermediate Shaft Bearing High Temperature input.

j. Pump High Vibration Switch input.

k. Motor High Vibration Switch input.

l. Motor Winding High Temperature output.

m. Pump Thrust Bearing High Temperature output.

n. Intermediate Shaft Bearing High Temperature output.

o. Pump High Vibration Switch output.

p. Motor High Vibration Switch output.

q. Motor Amperage analog output (4-20mA).

3. The following controls/indicators shall be mounted on the door of each VFD.

a. Manual-Off-Automatic switch.

b. Pump Running pilot light (green).

c. Pump Stopped pilot light (red).

d. Pump/VFD Failure pilot light (yellow).

e. Local/Remote speed selector switch.

f. Speed potentiometer.

g. Motor Winding High Temperature pilot light (white).

h. Pump Thrust Bearing High Temperature pilot light (white).

i. Intermediate Shaft Bearing High Temperature pilot light (white).

j. Pump High Vibration pilot light (white).

k. Motor High Vibration pilot light (white).

l. High Motor Amperage Alarm (white).

m. No Flow Alarm (white)*

n. High Discharge Pressure Alarm (white)

o. Reset pushbutton.

* No Flow Alarm shall be triggered by the VFD’s internal motor no load sensing.

PART 3 EXECUTION

3.01. GENERAL

A. Supply the VFD(s) with the controls specified herein and shown on the Contract Drawings.

B. The Contractor shall arrange for the VFD manufacturer or supplier to furnish the services of a qualified representative to check and supervise the installation and the preliminary testing for not less than two days, to supervise final testing for not less than two days, and to instruct the owner's operator(s) in proper operation at the time of final acceptance for not less than two days. The representative shall also provide an additional two days of training during the warrant period at a date requested by the Owner. A day is defined as eight hours. All days are actual on-site time. Travel and subsistence is the responsibility of the manufacturer's/supplier's representative.

C. Three copies of a complete operations and maintenance manual shall be submitted to the engineer per Section 01640.

D. Power wiring shall be completed by the electrical contractor, to NEC code 430.122 and adhering to local electrical codes, wiring requirements based on the VFD input current. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

3.02. FIELD TESTING

A. Field testing shall be in accordance with Section 01640 and as specified herein.

B. The Contractor shall coordinate VFD testing such that both the Owner and the Engineer are available to witness the testing. The Contractor shall contact both the Engineer and the Owner two weeks prior to the proposed test date. The representative of the equipment run by the VFD (pumps, fans) shall be present during VFD testing.

C. Shop drawing shall be available during testing.

D. A copy of the operations and maintenance manual shall be available during testing.

E. The Contractor shall verify that all systems have been electrically connected and that equipment is ready for operation.

F. Testing/Verification/Documentation

1. General explanation of each system shall be made.

2. Contractor/manufacturer/supplier shall have a written tabulation of all adjustable/settable parameters as set from the factory. In a separate column, all of the actual field adjusted/set values shall be shown.

3. Demonstrate the following and show how each is set/changed.

a. Manual operation both local/remote.

b. Minimum or default speed to be set for specific equipment operation.

c. Maximum set speed.

d. Adjust acceleration/deceleration times for proper equipment operation.

e. Restart after power outage.

f. Demonstrate starting into rotating motor (shut off circuit breaker and turn right back on).

g. Overcurrent/overvoltage (simulate with test equipment).

h. Overtemperature/low voltage (simulate with test equipment).

i. Phase Loss - Remove on fuse on supply voltage.

j. Auto operation (from input current or voltage signal).

k. Output contacts for alarm/run/status, etc., operate as required, simulate with test lights.

l. Units with bypass contactors/starters shall be operated in “bypass mode” demonstrating operation including shutdowns from remote devices.

A. Unit(s) shall operate without unusual or undue noises or vibrations.

TABLE 16480-1

VARIABLE FREQUENCY DRIVE APPLICATIONS

Units	HP (Each)	FLA (Each)	Type*	NEMA Enclosure	Bypass	Input Voltage
Union Hill Main Sewage Pumps (Typical For Pump Nos. 1 through 4)	150 (1800RPM)	168	5	NEMA 12 with Fan Filter	No	480V, 3 phase
Tallman Main Sewage Pumps (Typical For Pump Nos. 1 through 4)	150 (900 RPM)	187	5	NEMA 12 with Fan Filter	No	480V, 3 phase

*Type Drive:
1 Variable torque centrifugal pumping application.
2 Variable torque drive and conveyor application.
3 Variable torque air fan application.
4 Constant torque air pumping application.
5 Constant torque pumping application.
6 Constant torque drive application.

END OF SECTION

SECTION 16486

MOTOR CONTROL CENTERS

PART 1 GENERAL

1.01. SECTION INCLUDES

A. Scope

1. Contractor shall provide all labor, materials, equipment, services, and incidentals as shown, specified, and required to furnish and install motor control centers, complete and operational.

2. Motor control centers (MCC) required under this section are low-voltage, free-standing, metal enclosed equipment. Motor control centers shall be customized.

3. Motor control centers included in this section are associated with the following equipment:

a. UH-MCC.

b. T-MCC.

1.02. REFERENCES

NFPA 70	National Electrical Code
UL 198C	High-Interrupting Capacity Fuses; Current Limiting Type
UL 198E	Class R Fuses
NEMA AB 1	Molded Case Circuit Breakers
NEMA ICS 2	Industrial Control Devices, Controllers, and Assemblies
NEMA ICS 2.3	Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers
NEMA ICS 2	Industrial Control Devices Controllers and Assemblies
ANSI Z55.1	Gray Finishes for Industrial Apparatus and Equipment
UL 845	Motor Control Centers
NEMA ICS 18	Motor Control Centers

1.03. SUBMITTALS

A. Shop Drawings – phase, neutral, and ground; electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and time/current curves of all equipment and components; factory elementaries for each compartment.

B. Samples shall be submitted as may be requested by the Engineer.

C. Test Reports - Indicate field test and inspection procedures and test results.

D. The Contractor shall furnish a reproducible copy and four prints of the approved as-built wiring diagrams showing all wiring in the distribution and control center.

E. Manufacturer’s Installation Instructions - Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

F. Action Submittals: Submit the following:

1. Shop Drawings

a. Dimensional information and construction details of enclosures. Enclosure details shall consist of exterior and interior front door with nameplate legends, interior door front and rear views, and terminal block layout.

b. Contractor shall verify that field measurements are as indicated on shop drawings. Depth and Width shall match existing motor control centers to be replaced. Contractor shall verify existing dimensions in field.

c. Three-line power and control schematic diagrams.

d. Wiring diagrams showing the interconnection of conductors to all devices with terminal assignments for remote devices.

e. Functional description of system operation.

f. VFD/starter/circuit breaker heat dissipation at full load, including heat rejection/cooling system.

2. Product Data

a. Manufacturer’s technical specifications.

b. Manufacturer’s catalog cuts and product literature.

3. Testing Plans

a. Not less than thirty days prior to source quality control testing, submit descriptions of proposed shop testing methods, procedures, apparatus, and limitations.

b. Not less than thirty days prior to field quality control testing, submit descriptions of proposed field testing methods, procedures, and apparatus.

G. Seismic considerations: the Building Code of the State of New York, latest edition (including amendments) shall be in effect. Submit shop drawings for all electrical supports and anchors that include seismic restraint calculations and details as required to meet earthquake design data indicated on the structural drawings. Calculations and details, if required, shall be designed and stamped by a New York registered professional engineer retained by the Contractor.

H. Informational Submittals: Submit the following:

1. Certificates

a. Certification letters from low-voltage variable frequency drive manufacturer and motor manufacturer that the approved driven equipment has been reviewed and that variable frequency drive units and motors are compatible and shall be provided in accordance with the Contract Documents and requirements of the driven equipment.

2. Source Quality Control Submittals

a. Within five days of completing source quality control tests and inspections, submit test results with indication of whether all criteria of the Contract Documents for the specified equipment were met.

3. Field Quality Control Submittals

a. Within five days of completing field quality control tests and inspections, submit test results with indication of whether all criteria of the Contract Documents for the specified equipment were met.

4. Manufacturer Reports

a. Within five days of each visit to the site by manufacturer's representative, submit written report of reason for visit, problems encountered, solutions implemented, and remaining work.

5. Qualifications Statements

a. Manufacturer, when requested by the Engineer.

I. Closeout Submittals: Submit the following:

1. Operation and Maintenance Data

a. Submit complete installation, operation and maintenance manuals including test reports, maintenance data and schedules, description of operation, list of recommended spare parts, and spare parts ordering information.

b. Manuals shall include record drawings of control schematics, including point-to-point wiring diagrams.

c. Include a listing of all programmable drive parameters and their settings at Substantial Completion. Submit parameters as both printed pages in the operations and maintenance manual and in electronic format on compact disc that can be directly uploaded to the drive in event of drive replacement or repair.

d. Comply with Section 01640, Equipment- General, for requirements for Operations and Maintenance Data.

1.04. QUALITY ASSURANCE

A. Perform work in accordance with NEMA ICS 2.3.

B. Maintain one copy of each document on site.

1.05. QUALIFICATIONS

A. Manufacturer - Company specializing in manufacturing the products specified in this section with minimum three years' documented experience.

1.06. REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70, Underwriters Laboratories Publication UL-845, and NEMA Publication ICS-2.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. testing firm acceptable to authority having jurisdiction as suitable for purpose specified and indicated.

1.07. DELIVERY, STORAGE, AND HANDLING

A. Deliver in individual sections splits, individually wrapped for protection, and mounted on shipping skids such that the equipment may be delivered through existing building openings and doors.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle in accordance with NEMA ICS 2.3. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

1.08. ENVIRONMENTAL REQUIREMENTS

A. Conform to NEMA ICS 2 service conditions during and after installation of motor control centers compartments.

1.09. FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings. Depth and Width shall match existing motor control centers to be replaced. Contractor shall verify existing dimensions in field.

1.10. EXTRA MATERIALS

A. Provide the following materials, each tagged or conspicuously marked or labeled with the manufacturer's name, part number and name. All parts shall appear on a typed list showing the above plus quantity and location.

1. One box (minimum 10) of each size control power fuses furnished.

2. One set of starter contacts for every two starters or fraction thereof of each NEMA size installed.

3. One starter coil for every five NEMA size starters installed (all starters are full sized NEMA).

4. One control potential transformer for each size installed.

5. Four (4) control relays, timing relays and motor timing relays of each type used.

6. Six (6) sets of control relay contacts.

7. Six (6) sets of each N.O. and N.C. starter auxiliary contacts for each size starter provided.

8. Two (2) NEMA Size 1 starters.

9. Lamp replacer tool (if applicable)

10. One (1) fuse puller for each MCC, new or modified.

11. 36-inch wide, 1/4-inch thick corrugated switchboard matting. Lengths equal to each MCC with plus 2 feet. Shall comply with ANSI/ASTM D-178 J6-7 Type 2, Class 2 specifications. Available Lab Safety Supply (1-800-356-0783).

12. Any special tools needed to service the MCCs, but not normally found in a plant mechanic's toolbox.

PART 2 PRODUCTS

2.01. MANUFACTURERS

A. Square D, Model 6 series (Design Basis).

B. ABB, 9000 series.

C. Eaton, Freedom 2100 series.

2.02. GENERAL

A. Provide motor control center compartments as shown on the Drawings.

B. Motor Control Center Compartments - NEMA ICS 2, Class I, Type B-D wiring with terminal blocks mounted on lift out brackets in the vertical wire trough units for combination starters size 0-4. Type B-T wiring shall be provided for variable frequency drives installed within Motor Control Center Compartments.

C. Terminals - Accept all control and power wiring through Size 2.

D. Voltage Rating –480 volts, three phase, three wire, 60 Hertz as indicated on the drawings.

E. Integrated Equipment Short Circuit Rating - 65,000 amperes RMS symmetrical at 480 volts.

F. Configuration - Units front mounting only, accessible from the front only.

G. Bus – tin plated copper, furnish neutral and ground buses for entire length of MCC.

H. Enclosure - NEMA ICS 6, Type 12 with gasketed doors.

I. Dimensions

1. Depth and Width shall match existing motor control centers to be replaced. Contractor shall verify existing dimensions in field.

2. Vertical Sections - 6-1/2 space factors of unit mounting space or match existing.

3. Height - 91 inches.

J. Material

1. Exterior Frame - Fabricated from copper bearing reinforced steel plate construction.

K. Bus Barriers

1. Permit unit plug-on contacts to pass through and engage the vertical bus bars.

2. Unused Plug-On Openings - Provide plastic closing plates.

L. Plug-On Connections

1. Two-point connection to tighten around the vertical bus bar.

2. Material - Silver plated.

3. Cable Connections to the Plug-On Connections - Bolted type.

M. Bucket Alignment - Guide rails within the structure for horizontal and vertical alignment.

N. Horizontal wireways shall be provided at the top and bottom of each motor control center. Vertical wireways shall be provided when more than one compartment is provided in a single vertical section.

O. Horizontal and vertical bus ratings shall be provided as shown on the drawings (minimum), or as recommended by the manufacturer.

P. A copper ground bus shall be provided throughout the entirety of the motor control center’s length. Size as recommended by the manufacturer.

2.03. AUTOMATIC CONTROLLERS

A. Magnetic Motor Controllers - NEMA ICS 2, AC general purpose Class A magnetic controller for induction motors rated in horsepower. Minimum NEMA Size 0.

B. Reversing Controllers - Include electrical interlock and integral time delay transition between Forward and Reverse rotation.

C. Two-Speed Controllers - Include integral time delay transition between FAST and SLOW speeds.

D. Coil Operating Voltage - 120, 60 Hertz.

E. Overload Relay - NEMA ICS; melting alloy.

2.04. PRODUCT OPTIONS AND FEATURES TO BE PROVIDED

A. Auxiliary Contacts - NEMA ICS 2, 2 each normally open and closed contacts in addition to seal-in contact.

B. Cover Mounted Pilot Devices - NEMA ICS 2, heavy duty oiltight type. LED lamps, push-to-test type.

C. Pilot Device Contacts - NEMA ICS 2, Form Z, rated A150.

D. Surge Protective Device – Provide 160kA MOV type SPD with overcurrent protection as recommended by manufacturer. SPD shall include surge counter and LED status indicators.

E. Power Monitoring

1. A digital power monitoring device shall be provided as located on the drawings, including all PTs, CTs, fuses, wiring, etc.

2. Ammeter and Volt Meters

a. 1 percent of full scale.

b. Taut-band design type.

c. 4-1/2-inch rectangular type.

3. Measured parameters shall at a minimum include: kW, kVAR, kVA, True Power Factor, kWh, kVARh, kVAh, Voltage, Current, Frequency, Voltage Unbalance, Current Unbalance, kW Demand, kVAR Demand, kVA Demand, Max./Min. Logs, and Total Harmonic Distortion (THD).

4. Each motor control center main circuit breaker(s) shall have power monitoring with Modbus TCP/IP Ethernet communications capabilities. Each shall be Square D, PowerLogic PM5000 series, or equal.

2.05. DISCONNECTS

A. Combination Controllers - Combine motor controllers with thermal magnetic circuit breakers disconnect in common enclosure. Provide means for locking disconnect handle, and means for defeating cover interlock.

B. Motor Circuit Protector - NEMA AB 1, circuit breakers with integral instantaneous magnetic trip in each pole.

C. Disconnect Operator - All circuit disconnecting means shall be handle operated through approximately an 180 degree arc to open or close the device. With labeled and color coded “On,” “Off,” and “Tripped” position indicators. Provide means of locking disconnect in the “Off” position. Provide auxiliary contacts for disconnect switches, contacts shall be Early Break and Late Make.

2.06. SOURCE QUALITY CONTROL

A. Tests

1. Perform factory tests on each motor control center prior to shipping. Tests shall consist of simulating expected load to be driven (using a test motor supplied by the manufacturer) by operating load through speed ranges specified for driven equipment, for minimum of two hours per drive unit.

2. Provide factory control and alarm tests on each unit by simulating each control signal and each alarm function to verify proper and correct drive unit action.

3. Perform specified tests in addition to standard factory tests typically performed.

4. Submit type written factory test reports.

PART 3 EXECUTION

3.01. EXAMINATION

A. Verify that surface is suitable for motor control center compartments installation.

B. The manufacturer of this equipment will be permitted to arrange his equipment to the best advantage and will be required to furnish at least the spare compartments as noted on the Drawings.

C. Examine conditions under which the Work will be installed and notify the Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.02. INSTALLATION

A. Install motor control centers in accordance with manufacturer's instructions.

B. Tighten accessible bus connections and mechanical fasteners after placing motor control center.

C. Install fuses in fusible switches.

D. Select and install heater elements in motor starters to match installed motor characteristics.

E. Provide nameplates under the provisions of Section 16075, Electrical Identification.

F. Motor Data - Provide neatly typed label inside each motor starter door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

G. Wiring Diagrams - Elementary diagram shall be glued inside each compartment door housing a motor controller, relay, or similar equipment. Other compartments shall also have approved final unit wiring diagrams glued on the inside face of door as well as a heater selection table. Compartments containing panelboards shall have a circuit directory mounted inside the door. All diagrams shall reflect all field modifications.

H. Motor control centers shall be mounted on raised concrete bases unless noted otherwise. Connections to external equipment and connections of the incoming services shall be as shown or as required by the equipment manufacturer.

3.03. FIELD QUALITY CONTROL

A. Inspect each controller to NEMA ICS 2.

B. Site Tests

C. After installation, inspect, adjust, and test each low-voltage variable frequency drive or motor starter at the site. Testing and inspection shall be in accordance with manufacturer's recommendations and be performed by manufacturer's factory-trained representative. Through the Contractor, manufacturer's factory-trained representative shall inform the Owner and the Engineer when equipment is correctly installed and ready to be energized. Do not energize equipment without permission of the Owner and Engineer.

D. Perform the following equipment inspection and testing and provide reports documenting procedures and results.

1. Verify all device settings and drive adjustments.

2. Inspect all mechanical and electrical interlocks and controls for proper operation.

3. Test each starter/drive through specified speed ranges and loads for a minimum of two hours per drive unit.

4. Test each starter/drive by using actual control signal for remote and local operation.

5. Test each starter/drive alarm function.

6. Perform other tests recommended by equipment manufacturer.

E. Manufacturer Services

1. Unloading and Installation: Manufacturer's factory-trained representative shall be present during unloading of equipment and installation at equipment's final location. Representative shall train installing personnel in advance in the proper handling and rigging of equipment. Services by manufacturer's representative under this paragraph shall be at least (2) eight-hour days at the site.

2. Post-installation Check: Manufacturer's factory-trained representative shall check and approve the installed equipment before initial operation. Manufacturer shall calibrate, set and program low-voltage variable frequency drives provided. Services by manufacturer's representative under this paragraph shall be at least (2) eight-hour days at the site.

3. Manufacturer's factory-trained representative shall adjust the system to final settings as specified in Article 3.5 of this section.

4. Manufacturer's factory-trained representative shall test the system as specified in Paragraph 3.3.B of this section. Representative shall operate and test the system in presence of the Engineer and verify that equipment is in conformance with the Contract Documents. Services by manufacturer's representative under this paragraph shall be at least (3) eight-hour days at the site.

5. Representative shall revisit the site as often as necessary until all deficiencies are corrected, prior to readiness for final payment.

6. Provide services of manufacturer's factory-trained representatives to correct defective Work within 72 hours of notification by the Owner during the correction period specified in the General Conditions as may be amended by the Supplementary Conditions.

7. Replacement parts or equipment provided during the correction period shall be equal to or better than original.

8. Training: Provide services of qualified factory trained specialists from manufacturer to instruct Owner's operations and maintenance personnel in recommended operation and maintenance of equipment. Training shall be provided for a minimum of two (2), four (4) hour sessions and accommodate up to five of the Owner's personnel.

9. The Manufacturer Services specified within this section shall be in addition to the Manufacturer Services specified in Section 16480, Variable Frequency Drives, when applicable.

3.04. LABELING AND IDENTIFICATION

A. All interior relays, timers or other control devices shall be labeled according to its designation on the elementary diagram.

B. Each control center compartment (bucket) shall have its own identification nameplate fastened to the unit saddle. These nameplates shall have suitable references to factory records for efficient communication with supplier or manufacturer.

3.05. TESTING

A. Prior to connection of any external feeder or load circuits, MCC breakers shall be electrically tested.

B. Make all connections in accordance with the torquing specifications provided by the manufacturer.

C. All connections shall be given an infrared thermograph scan after the unit is operational and with each unit operating at as near full load as possible.

D. Contractor shall retorque or redo connections identified as potential problems.

E. Contractor shall individually adjust all trip units for the specific requirements of each device.

F. Contractor shall submit a letter of certification that all of the above have been done, are correct, and are fully operational.

END OF SECTION

SECTION 16510

LIGHTING FIXTURES

PART 1 GENERAL

1.01. DESCRIPTION

A. Scope

1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install lighting fixtures and associated controls.

B. Coordination

1. Coordinate location of fixtures with piping, ductwork, openings, and other systems and equipment and locate clear of interferences.

2. Coordinate fixtures to be mounted in hung ceilings with the ceiling suspension system proposed.

1.02. REFERENCES

A. Standards referenced in this Section are

1. UL 844, Luminaires for Use in Hazardous (Classified) Locations.

2. UL 1598, Safety of Luminaires.

1.03. QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the following:

1. NEC Article 410, Luminaires, Lampholders, and Lamps.

1.04. SUBMITTALS

A. Action Submittals: Submit the following:

1. Shop Drawings

a. Schedule of light fixtures to be furnished, indicating fixture type and location for each.

b. Customized wiring diagrams.

2. Product Data

a. Manufacturer's technical information, specifications, standard wiring diagrams, and catalog cuts for lighting fixtures proposed.

b. Fixture construction details.

c. ETL photometric and isocandle curves for each fixture proposed.

d. Verification that recessed fixtures to be mounted in hung ceilings are compatible with ceiling suspension system proposed.

B. Informational Submittals: Submit the following:

1. Manufacturer's Instructions

a. Instructions and recommendations for handling, storing, and protecting the equipment.

b. Installation instructions for the equipment, including setting drawings, templates, and directions and tolerances for installing anchorage devices.

c. List of spare parts recommended by the manufacturer. The list shall describe each part, the quantity recommended and unit price of each part.

1.05. PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery

1. Upon delivery, inspect equipment for evidence of water that may have entered equipment during transit.

B. Storage

1. Store lighting fixtures, controls, related materials and equipment in clean, dry location with controls for uniform temperature and humidity. Protect materials and equipment with coverings and maintain environmental controls.

2. Store materials and equipment for easy access for inspection and identification. Keep materials and equipment off ground, using pallets, platforms, or other supports. Protect materials and equipment from corrosion and deterioration.

PART 2 PRODUCTS

2.01. MATERIALS

A. Type: Lighting fixtures required shall be in accordance with the Lighting Fixture Schedule shown on the drawings. Fixtures shall be complete with supports, drivers, lamps, and incidentals, as required.

B. Fixtures in hazardous locations shall be listed in accordance with UL 1598 and UL 844.

C. Lamps

1. Light emitting diode (LED): Characteristics as shown on the fixture schedule

D. Fixtures located in area identified as hazardous in Section 16010, General Electrical Requirements, or as noted on the drawings shall each be approved as a complete assembly, shall be clearly marked to indicate maximum wattage of lamps for which they are approved, and be protected against physical damage by suitable guards.

E. Hardware: Provide necessary hangers, supports, conduit adaptors, reducers, hooks, brackets, and other hardware required for safe fixture mounting. Hardware shall have protective, non-corrosive finish.

F. Lighting Contactor and Controls

1. Provide a lighting contactor and control system for control of each area where shown on the Drawings.

2. Product and Manufacturer: Provide products of one of the following:

a. Type SM03 by Square D Company.

b. ASCO.

c. Or equal.

3. System shall include:

a. Enclosure sized as required, complete with input control fuse and screw type terminal blocks rated 300-volt, 20-amp quantity for all circuits, unless indicated otherwise on the Drawings.

b. Single coil, electrically-operated, mechanically-held contactor. Contactor shall be rated 30-amp, 600-volt, with 120-volt operating coil, unless indicated otherwise on the Drawings. Number of poles shall be as shown on the Drawings. Provide multiple contactors when necessary.

c. Enclosure: As required for area classification per Section 16010, General Electrical Requirements.

d. Identify panel in compliance with Section 16075, Electrical Identification.

PART 3 EXECUTION

3.01. INSPECTION

A. Examine conditions under which the Work will be installed and notify the Engineer in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions are corrected.

3.02. INSTALLATION

A. General

1. Fixture mounting heights and locations indicated on the Drawings are approximate and are subject to revision in the field where necessary to clear conflicts and obstructions.

2. Mounting Heights: Mounting heights or elevations are to bottom of fixture or to centerline of device.

3. Install fixtures in accordance with Laws and Regulations, the Contract Documents, and manufacturer instructions and recommendations.

4. Mount fixtures so that sufficient access is available for ready and safe maintenance.

5. Securely fasten equipment to walls or other surfaces on which equipment is mounted.

B. Suspended Fixtures

1. Pendant-mount using 1/2-inch diameter conduit stems.

2. Ground to outlet box.

3. Attach mounting to building structure with expansion anchors.

4. Fixtures shall not be dependent on the outlet box cover screws for support.

C. Surface Mounted Fixtures

1. Attach to appropriate outlet box.

2. Attach to surface using fasteners and sealing washers when mounting fixture in damp or wet locations.

D. Boxes and Fixtures

1. For units mounted against masonry or concrete walls, provide suitable 1/4-inch spacers to prevent mounting back of box directly against wall.

2. Bolt units rigidly to building with expansion anchors, toggle bolts, hangers, or Unistrut.

3. Do not install boxes with open conduit holes.

4. Cable each circuit and identify with tag.

E. Re-lamp all fixtures provided under this Contract with new lamps if failed at Substantial Completion.

F. Mount photocells as shown and adjust foot-candle setting for proper dusk and dawn photo-control. Provide wiring in conduit from photocell to controls.

END OF SECTION

SECTION 16620

PACKAGED ENGINE GENERATOR SYSTEM – DIESEL, WALK-IN ENCLOSURE

PART 1 GENERAL

1.01 WORK INCLUDED

A. Furnish and install 600 kW, diesel generator in walk-in sound attenuating enclosure with 1,700 gallon diesel fuel tank, 1200 A portable generator and load bank connection cabinet and all accessories as specified herein at the Tallman Pump Station.

1.02 CODES AND STANDARDS

A. The generator set installation and on-site testing shall conform to the requirements of the following codes and standards:

1. CSA 282, 1989 Emergency Electrical Power Supply for Buildings.

2. IEEE446 Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.

3. NFPA37

4. NFPA70 National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.

5. NFPA99 Essential Electrical Systems for Health Care Facilities.

6. NFPA110 Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit, component level type tests will not substitute for this requirement.

B. The generator set and supplied accessories shall meet the requirements of the following standards:

1. NEMA MG1-1998 part 32. Alternator shall comply with the requirements of this standard.

2. UL142 Sub-base Tanks.

3. UL1236 Battery Chargers.

4. UL2200. The generator set shall be listed to UL2200 or submit to an independent third party certification process to verify compliance as installed.

C. The control system for the generator set shall comply with the following requirements.

1. CSA C22.2, No. 14 B M91 Industrial Control Equipment.

2. EN50082-2, Electromagnetic Compatibility B Generic Immunity Requirements, Part 2: Industrial.

3. EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.

4. FCC Part 15, Subpart B.

5. IEC8528 part 4. Control Systems for Generator Sets.

6. IEC Std 801.2, 801.3, and 801.5 for susceptibility, conducted, and radiated electromagnetic emissions.

7. UL508. The entire control system of the generator set shall be UL508 listed and labeled.

8. UL1236 Battery Chargers.

D. The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

1.03 SUBMITTALS

A. Shop Drawings: Indicate electrical characteristics and connection requirements. Show plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, and electrical diagrams including schematic and interconnection diagrams.

B. Product Data: Provide data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, microprocessor control panel, battery, battery rack, battery charger, exhaust silencer, vibration isolators, fuel tank, trailer and radiator.

C. Prototype Test Reports: Submittals will not be received without submission of prototype test report as specified herein.

D. Manufacturer=s Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

E. Manufacturer’s Certificate: Certify that Products meet or exceed specified requirements.

F. Alternator data indicating sub transient reactance and temperature rise rating to meet requirements specified herein.

1.04 OPERATION AND MAINTENANCE

A. Manuals: Furnish four (4) Operation and Maintenance manuals.

B. Operation & Maintenance Data: Include instructions for routine maintenance requirements, service manuals for engine and day tank, oil sampling and analysis for engine wear, and emergency maintenance procedures.

1.05 QUALITY ASSURANCE

A. To provide proven reliability of the Generator set, three series of tests shall be performed, no exceptions taken:

1. Prototype model tests.

2. Fully assembled factory production model tests.

3. Field acceptance tests

B. The manufacturer shall provide documentation demonstrating satisfactory prototype and production test results. Generator sets that have not been prototype tested and Factory Production tested as described herein shall not be acceptable.

C. Generator set Prototype Tests: These tests and evaluations must have been performed on a prototype generator set representative of the model specified. A summary of the generator set testing results shall be submittal for review. The manufacturer=s standard series of components development tests on the generator system, engine and other major components shall be performed and available for review, but shall not be acceptable as a substitute for a prototype testing on the complete representative generator set prototype.

D. Torsiograph Analysis and Test: The manufacturer of the generator set shall verify that the engine generator set, as configured, is free from harmful torsional stresses. The analysis shall include correlation of empirical data from tests on a representative prototype. The empirical data must include spectrum analysis of the torsional transducer output within the operating speed range of the engine generator set. Calculations based on engine and generator separately are not acceptable.

E. Temperature Rise Test: Complete thermal evaluation of a prototype generator rotor and starter must include actual measurement of internal generator and exciter temperatures by embedded detector method, and measurement of average temperature rise by resistance method. No position measured any place in the windings may exceed the temperature rise limits of NEMA for the particular type of insulation system used. Resistance method temperature rise data shall be confirmed by a full load test on the generator set prototype to include conducted and radiated heat from the engine.

F. Short Circuit Test: A test on a prototype generator set shall have demonstrated that the generator set is designed to withstand the mechanical forces associated with a short circuit condition. With the generator set operating at rated load and speed, the generator terminals must be short circuited on all three phases for a duration of 20 seconds. At the conclusion of this test, the generator set must be capable of full load operation.

G. Endurance Run Test: A minimum of 500 continuous hours of endurance testing with a representative generator set prototype operating as defined by the manufacturer=s standby rating shall have been performed. Endurance testing shall be used to verify structural soundness and durability.

H. Maximum Power Test: With the prototype generator set at normal operating temperature and with all power consuming auxiliaries in place, the maximum power available at rated speed shall be determined with the governor set at its fuel stop. The generator set shall maintain this power for a minimum of two (2) minutes.

I. Linear Vibration Test: A test for in-line motion of components occurring along a repeatable path shall meet the manufacturer=s acceptable criteria.

J. Cooling System Test: A cooling system test shall demonstrate the ability of the generator set cooling system to maintain normal operating temperature while operating at full rated load and power factor at the highest ambient temperature (122 °F) of the system rating. Cooling air requirements, radiator air flow and maximum allowable restriction at radiator discharge shall be verified by this test.

K. Maximum Motor Starting KVA Test: Motor starting KVA shall be determined by test, based on a sustained RMS recovery voltage of at least 90 percent on no load voltage with the specified load KVA at near zero power factor applied to the generator set.

L. Transient Response, Steady State Speed Control and Voltage Regulation Test: Prototype generator set tests shall demonstrate consistent performance as follows; stable voltage and frequency at all loads from no load to full rated load, consistent frequency kp on load acceptance and rejection and restoration to steady state after sudden load changes. Transient response is a complete generator set (engine, generator, exciter, and regulator) performance criteria and cannot be established on generator data alone.

M. Witness-Generator Set Factory Production Tests: On the equipment to be shipped, a four (4) hour test shall be performed at rated load and 0.8 PF. These tests shall include certified data to document the following: run at full load, maximum power, voltage regulation, transient and steady state governing, single step load pickup and safety shutdowns. Provide a factory test record of the production testing. The equipment supplier at their expense shall coordinate and provide all transportation and lodging for the owner and Owner's engineering representatives, minimum of four (4) to witness the above stated factory test. Tests performed at facilities other than the manufacturer's factory shall not be acceptable.

N. Factory Test: The unit shall completely assembled and all preliminary adjustments made before the test is initiated. 600 KW genset shall be tested with the complete radiator and fan assembly to be shipped. Outside radiator, heat exchanger attachments shall not be acceptable.

O. Testing Procedure:

1. Test diesel-alternator unit at 0.8 PF in the following sequence:
2. 0.5 hour at ¼ load.
3. 0.5 hours at ½ load.
4. 0.5 hours at ¾ load.
5. 2.5 hours at full load.

P. Above testing shall be strip chart recorded and certified. During this test, the following measurements shall be taken and recorded on a certified report format:

1. Barometric Pressure.
2. Intake Air Pressure.
3. RPM.
4. Output voltage per phase.
5. Output amperes per phase.

6. Power Factor.

7. KW.

8. Winding temperature.

9. Transient response testing sequence:

10. 0-25%, 25%-0.

11. 0-50%, 50%-0.

12. 0-75%, 75%-0.

13. 0-100%, 100%-0.

Q. Above testing shall be strip chart recorded. Provide necessary equipment and instruments to measure voltage dips and frequency dips. Comparison shall be made to the herein specified alternator performance characteristics prior to acceptance.

R. Field Acceptance Tests: Generator supplier shall provide and conduct a four (4) hour load bank test at unity power factor for the generator set. Provide portable load bank for testing generator set at 100% load. Load bank test shall test each generator at full nameplate KW ratings. Generator manufacturer's representative shall record test data, as described below. Test data shall be tabulated and typed for submission and approval by the engineer for final acceptance. No handwritten field notes will be allowed. Installing contractor shall provide assistance as required for connecting and disconnecting portable load-bank by generator supplier.

S. Initial startup and field acceptance tests are to be conducted by the authorized representative of the system manufacturer who supplies the equipment. Contractor responsible for protection of testing equipment and any additional cable, etc., required if equipment cannot be located internally during testing.

T. Test data shall be collected and recorded on the following: Time of day, coolant temperature, operating oil pressure, battery charging rate, cranking time, crank-to-rated frequency time, voltage and frequency overshoot, load assumption-to-steady state voltage and frequency stabilization time, operating voltage, frequency, current, kilowatts and power factor. All data shall be taken every fifteen (15) minutes.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years documented experience, and with an authorized distributor offering 24 hour parts and service availability within 50 miles of the project. Proposed engine/generator combination shall have been in production a minimum of five (5) years.

B. Supplier: Authorized distributor of specified manufacturer with minimum five (5) years documented experience with specified products and factory-trained service technicians.

1.07 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70, NFPA 110, and NFPA 101.

B. Furnish Products listed and classified by Underwriters Laboratories as suitable for purpose specified and indicated.

1.08 PRE-INSTALLATION CONFERENCE

A. Convene one (1) week prior to commencing work of this Section.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site.

B. Accept unit on site mounted on trailer. Inspect for damage. Provide written verification that Genset tested and Genset received are one and the same.

C. Protect equipment from dirt and moisture by securely wrapping in heavy plastic during construction.

1.10 EXTRA MATERIALS

A. Provide two (2) of each fuel, oil and air filter element, engine belts and hoses.

B. Provide one (1) spare block heater.

1.10 WARRANTY

A. A no deductible comprehensive warranty shall be provided for all products against defects in materials and workmanship for a five-year or 1500 hour period from the start-up date. Warranty shall cover all costs of covered repairs, including travel expenses.

1.12 SERVICE AGREEMENT

A. Manufacturer shall provide Owner with a Two (2) year service agreement that includes changing all fluids and filters once a year and a minor inspection six (6) months after each change.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design manufacturer:

1. Cummins Power Generation, model DQCA rated for STANDBY POWER with HC6H Frame Alternator as distributed by Cummins Power Sytems, LLC, 890 Zerega Avenue, Bronx, NY 10473.

B. It is intended that all products specified herein be of standard ratings, therefore, the KW and KVA, starting KVA and maximum allowable voltage dip, ratings, etc., shall be the manufacturer’s next size or rating to exactly meet the specifications. No exceptions.

C. Substitute manufacturers shall provide a complete statement of compliance indicating meeting or deviating from these specifications.

2.02 DIESEL ENGINE-GENERATOR SET

A. Ratings

1. The generator set shall operate at 1800 rpm and at a voltage of: 480 Volts AC, 3-phase, 4-wire, 60 hertz.

2. The generator set shall be rated at 600 kW, 750 kVA at 0.8 PF, standby rating, based on site conditions of: Altitude 1,000 ft., ambient temperatures up to 50°C degrees F.

B. Performance

1. Voltage regulation shall be plus or minus 0.5 percent for any constant load between no load and rated load. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus 0.5 percent.

2. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 0.25%.

3. The diesel engine-generator set shall accept a single step load of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.

   Motor starting capability shall be a minimum of 3313 kVA. The generator set shall be capable of recovering to a minimum of 90% of rated no load voltage following the application of the specified kVA load at near zero power factor applied to the generator set.

4. The alternator shall produce a clean AC voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic, and no 3rd order harmonics or their multiples. Telephone influence factor shall be less than 40.

5. The generator set shall be certified by the engine manufacturer to be suitable for use at the installed location and rating, and shall meet all applicable exhaust emission requirements at the time of commissioning.

C. Construction

1. The engine-generator set shall be mounted on a heavy-duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails.

2. All switches, lamps, and meters in the control system shall be oil-tight and dust-tight. All active control components shall be installed within a UL/NEMA 3R enclosure. There shall be no exposed points in the control (with the door open) that operate in excess of 50 volts.

D. Connections

1. The generator set load connections shall be composed of silver or tin plated copper bus bars, drilled to accept mechanical or compression terminations of the number and type as shown on the drawings. Sufficient lug space shall be provided for use with cables of the number and size as shown on the drawings.

2. Power connections to auxiliary devices shall be made at the devices,[with required protection located at a wall-mounted common distribution panel] If walk-in enclosure.

3. Generator set control interfaces to other system components shall be made on a permanently labeled terminal block assembly. Labels describing connection point functions shall be provided.

2.03 ENGINE AND ENGINE EQUIPMENT

E. The engine shall be diesel, minimum EPA TIER 2 Certified, 4 cycle, radiator and fan cooled. Minimum displacement shall be 1413 cubic inches, with 6 cylinders. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. Two cycle engines are not acceptable.

F. A digital electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed. The governing system shall include a programmable warm up at idle and cooldown at idle function. While operating in idle state, the control system shall disable the alternator excitation system.

G. Skid-mounted radiator and cooling system rated for full load operation in 122 degrees F (50 degrees C) ambient as measured at the alternator air inlet. Radiator fan shall be suitable for use in a system with 0.5 in H_2O restriction. Radiator shall be sized based on a core temperature that is 20F higher than the rated operation temperature, or prototype tested to verify cooling performance of the engine/radiator/fan operation in a controlled environment. Radiator shall be provided with a duct adapter flange. The equipment manufacturer shall fill the cooling system with a 50/50-ethylene glycol/water mixture prior to shipping. Rotating parts shall be guarded against accidental Electric starter(s) capable of three complete cranking cycles without overheating.

2.04 ENGINE ACCESSORY EQUIPMENT

A. The engine for the generator shall include the following accessories:

1. Positive displacement, contact.

2. Mechanical, full pressure, lubrication oil pump.

3. Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicator.

4. An engine driven, mechanical, positive displacement fuel pump. Fuel filter with replaceable spin-on canister element. Fuel cooler, suitable for operation of the generator set at full rated load in the ambient temperature specified shall be provided if required for operation due to the design of the engine and the installation.

5. Replaceable dry element air cleaner with restriction indicator.

6. Flexible supply and return fuel lines.

7. Engine mounted battery charging alternator, 40-ampere minimum, and solid-state voltage regulator.

B. Coolant heater

1. Engine mounted, thermostatically controlled, coolant heater for each engine. Heater voltage shall be as shown on the project drawings. The coolant heater shall be UL499 listed and labeled.

2. The coolant heater shall be installed on the engine with silicone hose connections. Steel tubing shall be used for connections into the engine coolant system wherever the length of pipe run exceeds 12 inches. The coolant heater installation shall be specifically designed to provide proper venting of the system. The coolant heaters shall provisions to isolate the heater for replacement of the heater element without draining the coolant from the generator set. The quick disconnect/automatic sealing couplers shall allow the heater element to be replaced without draining the engine cooling system or significant coolant loss.

3. The coolant heater shall be provided with a 24VDC thermostat, installed at the engine thermostat housing. An AC power connection box shall be provided for a single AC power connection to the coolant heater system.

4. The coolant heater(s) shall be 208V, 4500 watts and sized as recommended by the engine manufacturer to warm the engine to a minimum of 104F (40C) in a 40F (4C) ambient, in compliance with NFPA110 requirements, or the temperature required for starting and load pickup requirements of this specification.

C. Provide spring vibration isolators, Seismic rated spring type, quantity as recommended by the generator set manufacturer. Isolators shall include seismic restraints if required by site location.

D. Starting and Control Batteries shall be calcium/lead antimony type, 24 volt DC, sized as recommended by the engine manufacturer, complete with battery cables and connectors. The batteries shall be capable of a minimum of three complete 15-second cranking cycles at 40F ambient temperature when fully charged.

E. Provide exhaust silencer(s) for each engine of size and type as recommended by the generator set manufacturer and approved by the engine manufacturer. The mufflers shall be critical grade installed inside enclosure.

F. A UL listed/CSA certified 12 amp voltage regulated battery charger shall be provided for each engine-generator set. The charger shall be located inside the enclosure. Input AC voltage and DC output voltage shall be as required. Chargers shall be equipped with float, taper and equalize charge settings. Operational monitors shall provide visual output along with individual form C contacts rated at 4 amps, 120 VAC, 30VDC for remote indication of:

Loss of AC power – red light
Low battery voltage – red light
High battery voltage – red light
Power ON – green light (no relay contact)

G. Charger shall include an Analog DC voltmeter and ammeter, 12 hour equalize charge timer, and AC and DC fuses.

2.05 AC ALTERNATOR

A. The AC generator shall be; synchronous, four pole, 2/3 pitch, revolving field, drip-proof construction, single prelubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system and shall be UL1446 listed. Actual temperature rise measured by resistance method at full load shall not exceed 80 degrees Centigrade.

B. The generator shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage not more than 5 percent above or below rated voltage.

C. A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at approximately 300% of rated current for not more than 10 seconds.

D. The sub-transient reactance of the alternator shall not exceed 12.2 percent, based on the 80°C rise rating.

E. Alternator shall be rated for a minimum of 720 KW at 80°C, 277/480 VAC standby.

2.06 ENGINE GENERATOR SET CONTROL

A. Generator set Control. The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification.

B. The control shall be mounted on the generator set, or may be mounted in a free-standing panel next to the generator set if adequate space and accessibility is available. The control shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered.

C. Control Switches

1. Mode Select Switch. The mode select switch shall initiate the following control modes. When in the RUN or MANUAL position the generator set shall start, and accelerate to rated speed and voltage as directed by the operator. A separate push-button to initiate starting is acceptable. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.

2. EMERGENCY STOP switch. Switch shall be Red “mushroom-head” push-button. Depressing the emergency stop switch shall cause the generator set to immediately shut down, and be locked out from automatic restarting.

3. RESET switch. The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.

4. PANEL LAMP switch. Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.

D. Generator Set AC Output Metering. The generator set shall be provided with a metering set including the following features and functions:

1. Digital metering set, .5% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three-phase voltages (line to neutral or line to line) simultaneously.

2. Analog voltmeter, ammeter, frequency meter, power factor meter, and kilowatt (KW) meter. Voltmeter and ammeter shall display all three phases. Meter scales shall be color coded in the following fashion: green shall indicate normal operating condition, amber shall indicate operation in ranges that indicate potential failure, and red shall indicate failure impending. Metering accuracy shall be within 1% at rated output. Both analog and digital metering are required.

3. The control system shall monitor the total load on the generator set, and maintain data logs of total operating hours at specific load levels ranging from 0 to 110% of rated load, in 10% increments. The control shall display hours of operation at less than 30% load and total hours of operation at more than 90% of rated load.

4. The control system shall log total number of operating hours, total kWH, and total control on hours, as well as total values since reset.

E. Generator Set Alarm and Status Display.

1. The generator set control shall include LED alarm and status indication lamps. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. Functions indicated by the lamps shall include:

   a. The control shall include five configurable alarm-indicating lamps. The lamps shall be field adjustable for any status, warning, or shutdown function monitored by the genset. They shall also be configurable for color, and control action (status, warning, or shutdown).

   b. The control shall include green lamps to indicate that the generator set is running at rated frequency and voltage, and that a remote start signal has been received at the generator set. The running signal shall be based on actual sensed voltage and frequency on the output terminals of the generator set.

   c. The control shall include a flashing red lamp to indicate that the control is not in automatic state, and red common shutdown lamp.

   d. The control shall include an amber common warning indication lamp.

2. The generator set control shall indicate the existence of the warning and shutdown conditions on the control panel. All conditions indicated below for warning shall be field-configurable for shutdown. Conditions required to be annunciated shall include:

   Low oil pressure (warning)
   Low oil pressure (shutdown)
   Oil pressure sender failure (warning)
   Low coolant temperature (warning)
   High coolant temperature (warning)
   High coolant temperature (shutdown)
   High oil temperature (warning)
   Engine temperature sender failure (warning)
   Low coolant level (warning)
   Fail to crank (shutdown)
   Fail to start/overcrank (shutdown)
   Overspeed (shutdown)
   Low DC voltage (warning)
   High DC voltage (warning)
   Weak battery (warning)
   Low fuel-daytank (warning)

High AC voltage (shutdown)
Low AC voltage (shutdown)
Under frequency (shutdown)
Over current (warning)
Over current (shutdown)
Short circuit (shutdown)
Ground fault (warning) (optional—when required by code or specified)
Over load (warning)
Emergency stop (shutdown)
(4) configurable conditions

3. Provisions shall be made for indication of four customer-specified alarm or shutdown conditions. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above-specified conditions. The non-automatic indicating lamp shall be red, and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.

F. Engine Status Monitoring.

1. The following information shall be available from a digital status panel on the generator set control:

engine oil pressure (psi or kPA)
engine coolant temperature (degrees F or C)
engine oil temperature (degrees F or C)
engine speed (rpm)
number of hours of operation (hours)
number of start attempts
battery voltage (DC volts)

2. The control system shall also incorporate a data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set, as well as total time of operation at various loads, as a percent of the standby rating of the generator set.

3. Provide and install a 20-light LED type remote alarm annunciator with horn, located as shown on the Drawings or in a location that can be conveniently monitored by facility personnel. The remote annunciator shall provide all the audible and visual alarms called for by NFPA Standard 110 for level 1 systems for the local generator control panel. Spare lamps shall be provided to allow future addition of other alarm and status functions to the annunciator. Provisions for labeling of the annunciator in a fashion consistent with the specified functions shall be provided. Alarm silence and lamp test switch(es) shall be provided. LED lamps shall be replaceable, and indicating lamp color shall be capable of changes needed for specific application requirements. Alarm horn (when switched on) shall sound for first fault, and all subsequent faults, regardless of whether first fault has been cleared, in compliance with NFPA110 3-5.6.2. The interconnecting wiring between the annunciator and other system components shall be monitored and failure of the interconnection between components shall be displayed on the annunciator panel.

The annunciator shall include the following alarm labels, audible annunciation features, and lamp colors:

Condition	Lamp Color	Audible Alarm
Genset Supplying Load	Amber	No
Charger AC Failure	Amber	Yes
Low Coolant Level	Amber	Yes
Low Fuel Level	Red	Yes
Check Genset	Amber	No
Not In Auto	Red	Yes
Genset Running	Amber	No
High Battery Voltage	Amber	Yes
Low Battery Voltage	Red	Yes
Weak Battery	Red	Yes
Fail to Start	Red	Yes
Low Coolant Temperature	Red	Yes
Pre-High Engine Temperature	Amber	Yes
High Engine Temperature	Red	Yes
Pre-Low Oil Pressure	Red	Yes
Low Oil Pressure	Red	Yes
Overspeed	Red	Yes
(4) Spares	Configurable	Configurable

2.07 ENGINE CONTROL FUNCTIONS

A. The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and # of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15-second rest period between cranking periods.

B. The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled. Total duration of operating time in the idle mode shall be controlled by the system, to prevent degradation of the engine capabilities due to excess operating time at idle.

C. The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting.

D. The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.

E. The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components, and an actual failure conditions.

2.08 ALTERNATOR CONTROL FUNCTIONS

A. The generator set shall include a full wave rectified automatic digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from misoperation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase line to neutral RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below an adjustable frequency threshold. Torque matching characteristic shall be adjustable for roll-off frequency and rate, and be capable of being curve-matched to the engine torque curve with adjustments in the field. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level. Rotary potentiometers for system adjustments are not acceptable.

B. Controls shall be provided to monitor the output current of the generator set and initiate an alarm (over current warning) when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (over current shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445.

C. Controls shall be provided to individually monitor all three phases of the output current for short circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (short circuit shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445.

D. Controls shall be provided to monitor the KW load on the generator set, and initiate an alarm condition (over load) when total load on the generator set exceeds the generator set rating for in excess of 5 seconds. Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.

E. An AC over/under voltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.

2.09 OTHER CONTROL FUNCTIONS

A. A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is less than 25VDC or more than 32 VDC. During engine cranking (starter engaged), the low voltage limit shall be disabled, and DC voltage shall be monitored as load is applied to the battery, to detect impending battery failure or deteriorated battery condition.

2.10 GENERATOR MAIN LINE CIRCUIT BREAKERS & PROTECTION

A. The generator set shall be provided with genset mounted 1000 amp main line 100% rated circuit breakers. The circuit breaker shall incorporate an electronic trip unit that operates to protect the alternator under all overcurrent conditions, or thermal-magnetic trip with other overcurrent protection devices that positively protect the alternator under overcurrent conditions. The supplier shall submit time overcurrent characteristic curves and thermal damage curve for the alternator, demonstrating the effectiveness of the protection provided.

B. The generator set shall be provided with a utility grade protective relay, designed to provide thermal overload protection for the alternator, and performance certified for that purpose by a 3rd party testing organization. The supplier shall submit time overcurrent characteristic curves and thermal damage curve for the alternator, demonstrating the effectiveness of the protection provided. Relay shall be installed to allow shutdown of the generator excitation system on an alternator overload condition, with the engine operating for a cool-down period before shutdown. The relay shall not include an instantaneous trip function.

2.11 WALK IN SOUND ENCLOSURE AND 1700 GALLON UL SUB BASE TANK

A. Walk-in sound enclosure & 1,700-gallon sub-base tank shall be as manufactured by Acoustical Sheetmetal Corporation, 2600 Production Road, Virginia Beach, VA 23454.

B. Structure: Frame of enclosure to be fabricated of structural steel tubing. All steel material to conform to A.S.T.M. A-36. All connections to be full welds by technicians certified under A.S.M.E. Section IX. All steel to be free from rust and defects. Entire frame to be primed and painted with two coats of epoxy paint. All members to be straight, true and at right angles to connecting parts. Overall dimensional tolerance to be plus or minus 1/8".

C. Aluminum Skin: Enclosure to be covered with 14 gauge (0.063") pre-painted aluminum, color white, bronze, or mill finish marine grade aluminum. Aluminum to be separated from steel with 1/8" closed cell rubber foam insulation. All fasteners to be made of non-corrosive materials. All panel fasteners will not be visible on the exterior. Solid aluminum rub rails will surround the top and bottom perimeters, caulked with silicone sealant and secured with stainless steel self-tapping screws. Roof panel joints to have continuous covers, sealed and secured to steel frame with corrosion resistant fasteners. Color to be selected from manufacturer's standard options by Owner.

D. Insulation: Three inch (3") thick panels double wall construction filled 100% with sound absorbing Fiberglass insulation with a flame spread of 10, fuel contributed of 0 and a smoke developed 0, to be placed at walls and ceiling covered with 18 gauge (.040) mill-finished perforated aluminum. Air intake and discharge chambers to be insulated to restrict the transmission of generator set noise. Entire assembly shall be able to reduce generator set noise in free field to 75 dB/A at a distance of 21 feet from enclosure in any direction.

E. Access: All doors to be made of the same material as the enclosure skin, two solid double doors, 72"wide x 72"high on side of enclosure. Hinges to be butt hinges of solid stainless steel. Door handles to be three-point latch type, with panic release from inside of enclosure keyed alike. Lock materials to be made of non-corrosive materials. Stainless steel door holders will be installed on swinging doors. Rain gutters to be placed over all doors. Lift out type doors to be used in areas of reduced access.

F. Air Intake: External sound absorbing rear mounted hood with internal sound absorbing baffle system with galvanized motor operated dampers. Size of louver to be sufficient to meet combustion and cooling air movement requirements. Air intake louvers to have bird screen mesh to prevent ingestion of debris. Air velocity shall not exceed 1000 feet per minute. An internal motor operated damper shall be installed and wired to the generator set.

G. Air Discharge**:** External sound absorbing vertical plenum with internal sound absorbing baffle system, birdscreen, and gravity louvers.

H. Accessories: Muffler brackets to be solid aluminum structural angle, welded as one piece for internal installation from a super critical sound absorber muffler. Muffler straps provided to be custom fit for the muffler. Insulation for interior muffler/flex and exhaust pipe provided and installed. Aluminum rain caps and collars made to prevent rain intrusion at roof penetration. Engine oil and water drains to be extended to exterior of enclosure**.**

I. Electrical Accessories:

2 Power Panelboard to be 100 Amp, three phase, 120/208 VAC
2 2 Foot LED strip type lights
2 Light switches.
2 Duplex receptacles.
2 Junction boxes for battery charger and jacket water heater connection
2 Connection for motor operated damper to junction box or generator control panel
2 Connection for low alarm, high alarm, leak alarm
2 Exhaust fan with thermostat and gravity louver
2 Space heater with thermostat, 5 KW
2 External emergency break glass station
1 18” Exhaust fan with thermostat
2 Exterior LED lights
1 Photocell
2 Emergency Break glass stations
2 Emergency Dual head lights

All electrical accessories shall be pre-installed by the enclosure manufacturer and pre-wired in rigid steel conduit.

J. Steel Base to be fabricated of structural steel channel with 3/16: thick diamond plate floor conforming to the requirements of A.S.T.M. A-36. All steel to be new and free from rust and scaling. All steel members to be primed and painted with no less than two coats of epoxy paint. Steel cross members to be of structural steel channel. Strategically placed to support the generator set. Steel angle will be placed under the seams of the floor material to provide continuous support.

K. Plates to be welded in such a manner as to prevent buckling. All welds to be performed by technicians certified under A.S.M.E. Section IX. Top and bottom of floor to be primed and painted with no less than two coats of epoxy paint. Floor cutouts (electrical stub-up area) shall be provided as necessary to provide access to the electrical connections area of the generator set. Fuel storage compartments under floor shall be designed and fabricated in compliance with Underwriter’s Laboratories Standard UL 142 Specifications. The rupture tank shall meet the same specifications for integrity and strength.

L. Provide a sub-base nominal 1,700 gallon fuel tank for the generator set. The sub- base fuel tank shall be UL142 listed and labeled. Installation shall be in compliance to NFPA 37. The fuel tank shall be a double-walled, steel construction and include the following features:

1. Emergency tank and basin vents.

2. Mechanical level gauge.

3. Fuel supply and return lines, connected to generator set with flexible fuel lines as recommended by the engine manufacturer and in compliance to NFPA 37 requirements.

4. Leak detection provisions, wired to the generator set control for local and remote alarm indication.

5. Low level float switches to indicate fuel level. Wire switches to generator control for local and remote indication of fuel level.

6. Basin drain.

7. Integral lifting provisions.

M. COUPLING/VENTS AND ALARM SWITCHES FOR FUEL BASE STORAGE TANK

A: ¾" Fuel pickup and return piping

B: 2" Vent to outside from enclosure

C: 1 ½" Mechanical fuel level gauge

D: 2" Lockable fuel fill cap with 7 Gallon spill container

E: 1" Drain coupling with plug

F: 1 ¼" High/low fuel level alarm switch

G: 8" Emergency vent with 2" Spare Couplings with plugs

N. COUPLING/VENTS AND ALARM SWITCHES FOR RUPTURE TANK

A: 1" Drain coupling with plug

B: 1 ¼" Leak alarm switch

C: 8" Emergency vent

O. Supports and "D" type lifting rings shall be provided at such location as to provide for balanced lifting at the enclosure, generator set and base assembly.

P. Two inch (2") high environmental protection barrier placed around electrical stub- up area and enclosure interior wall to help prevent liquid spill-over to the environment.

Q. Provide galvanized steel access platforms with stairs and railings. Height as required and as shown on the drawings.

2.12 Portable Generator and Load Bank Connection Cabinet

A. Provide portable generator connection cabinet, configured as shown on the drawings.

B. Enclosure shall be NEMA 4X, 304 stainless steel, brushed finish.

C. The cabinet set shall be provided with molded-case circuit breakers, as shown on the drawings, 100% rated. The circuit breaker shall incorporate an electronic trip unit with LSI functions. The circuit breakers shall be key interlocked with the generator main line circuit breaker.

D. Color-coded cam style male inlets (3 sets), 400A rated, arranged for 480/277V, 3Ø, 4-wire service plus ground for the portable generator connection.

E. Color-coded cam style female outlets (3 sets) 400A rated, arranged for 480/277V, 3Ø 3-wire service plus ground for the load bank connection.

F. Provide door mounted, green LED pilot light to indicate voltage present.

G. Provide low-voltage terminal block for engine start signal from Automatic Transfer Switch.

H. UL 1008 listed.

PART 3 EXECUTION

3.01 ACCEPTANCE

A. Equipment shall be initially started and operated by representatives of the manufacturer.

B. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to final testing of the system.

C. System start-up shall be coordinated with automatic transfer switch start-up. See Section 16413 for additional requirements.

3.02 TRAINING

A. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than two (2) four (4) hours sessions in duration and the class size shall be limited to five (5) persons. Training date shall be coordinated with the facility owner.

3.03 DEMONSTRATION

A. Provide systems demonstration. Electrical Contractor shall provide fuel for testing and shall fill tank complete after all testing is done and before turning over to Owner.

B. Describe loads connected to standby system and restrictions for future load additions.

C. Simulate power outage by interrupting normal source and demonstrate that system operates to provide standby power.

END OF SECTION

SECTION 16621

GENERATOR CONVERSION TO PORTABLE

PART 1 GENERAL

1.01 WORK INCLUDED

A. Girtz Industries to package a customer supplied Cummins 450kW 480V generator at the Tallman Pump Station with Miratech aftertreatment system into a modified 40' HC ISO container. The air intake will be through fixed blade rain louvers located on the side and rear doors of the container. The engine exhaust will be directed up and out of the container through a screened frame in the roof after passing through the Miratech aftertreatment system. A 1600 gallon UL 142 Listed, day diesel fuel day tank will be installed and plumbed to the engine.

1.02 CODES AND STANDARDS

A. The generator set installation and on-site testing shall conform to the requirements of the following codes and standards:

1. CSA 282, 1989 Emergency Electrical Power Supply for Buildings.

2. IEEE446 Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.

3. NFPA37

4. NFPA70 National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.

5. NFPA99 Essential Electrical Systems for Health Care Facilities.

6. NFPA110 Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit, component level type tests will not substitute for this requirement.

B. The generator set and supplied accessories shall meet the requirements of the following standards:

1. NEMA MG1-1998 part 32. Alternator shall comply with the requirements of this standard.

2. UL142 Sub-base Tanks.

3. UL1236 Battery Chargers.

4. UL2200. The generator set shall be listed to UL2200 or submit to an independent third party certification process to verify compliance as installed.

C. The control system for the generator set shall comply with the following requirements.

1. CSA C22.2, No. 14 B M91 Industrial Control Equipment.

2. EN50082-2, Electromagnetic Compatibility Generic Immunity Requirements, Part 2: Industrial.

3. EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.

4. FCC Part 15, Subpart B.

5. IEC8528 part 4. Control Systems for Generator Sets.

6. IEC Std 801.2, 801.3, and 801.5 for susceptibility, conducted, and radiated electromagnetic emissions.

7. UL508. The entire control system of the generator set shall be UL508 listed and labeled.

8. UL1236 Battery Chargers.

D. The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

1.03 SUBMITTALS

A. Shop Drawings: Indicate electrical characteristics and connection requirements. Show plan and elevation views with overall and interconnection point dimensions, enclosure plans and sections, ventilation and combustion air requirements, and electrical diagrams including schematic and interconnection diagrams.

B. Product Data: Provide data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, microprocessor control panel, battery, battery rack, battery charger, exhaust silencer, vibration isolators, fuel tank, trailer and radiator.

C. Manufacturer’s Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

D. Manufacturer’s Certificate: Certify that Products meet or exceed specified requirements.

E. Alternator data indicating sub transient reactance and temperature rise rating to meet requirements specified herein.

1.04 OPERATION AND MAINTENANCE

A. Manuals: Furnish four (4) Operation and Maintenance manuals.

B. Operation & Maintenance Data: Include instructions for routine maintenance requirements, service manuals for engine and day tank, oil sampling and analysis for engine wear, and emergency maintenance procedures.

1.05 QUALITY ASSURANCE

A. Field Acceptance Tests: Generator supplier shall provide and conduct a four (4) hour load bank test at unity power factor for the generator set. Provide portable load bank for testing generator set at 100% load. Load bank test shall test each generator at full nameplate KW ratings. Generator manufacturer's representative shall record test data, as described below. Test data shall be tabulated and typed for submission and approval by the engineer for final acceptance. No handwritten field notes will be allowed. Installing contractor shall provide assistance as required for connecting and disconnecting portable load-bank by generator supplier.

B. Initial startup and field acceptance tests are to be conducted by the authorized representative of the system manufacturer who supplies the equipment. Contractor responsible for protection of testing equipment and any additional cable, etc., required if equipment cannot be located internally during testing.

C. Test data shall be collected and recorded on the following: Time of day, coolant temperature, operating oil pressure, battery charging rate, cranking time, crank-to-rated frequency time, voltage and frequency overshoot, load assumption-to-steady state voltage and frequency stabilization time, operating voltage, frequency, current, kilowatts and power factor. All data shall be taken every fifteen (15) minutes.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years documented experience, and with an authorized distributor offering 24 hour parts and service availability within 50 miles of the project. Proposed engine/generator combination shall have been in production a minimum of five (5) years.

B. Supplier: Authorized distributor of specified manufacturer with minimum five (5) years documented experience with specified products and factory-trained service technicians.

1.07 REGULATORY REQUIREMENTS

A. Conform to requirements of NFPA 70, NFPA 110, and NFPA 101.

B. Furnish Products listed and classified by Underwriters Laboratories as suitable for purpose specified and indicated.

1.08 PRE-INSTALLATION CONFERENCE

A. Convene one (1) week prior to commencing work of this Section.

1.09 PROJECT COORDINATION

A. Contractor to deliver existing genset (Cummins 450kW 480V) to Girtz. Removal of the generator and all associated components within the existing enclosure shall be provided by the contractor and delivered to Girtz for the new trailer upfit. Discarding of existing enclosure & associated unused components shall be by the contractor.

B. Generator shall be provided with engine-mounted radiator.

C. Cummins to provide complete Miratech Tier 4 aftertreatment system and all components.

D. Customer will choose a Girtz standard paint color.

E. Cummins will provide accurate drawings for all equipment listed above or any additional equipment not listed.

F. Cummins will supply all necessary components for engine/genset to run as a stand-alone unit in the form of a complete genset.

G. All components may be stored outside in cold weather. All customer supplied components must be winterized prior to shipment to Girtz.

H. Build of unit will not begin until submittal drawings are approved and all issues are resolved.

1.10 WARRANTY

A. A no deductible comprehensive warranty shall be provided for all products against defects in materials and workmanship for a one-year or 300 hour period from the start-up date. Warranty shall cover all costs of covered repairs, including travel expenses.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design manufacturer:

1. Girtz Industries and Cummins Power Generation distributed by Cummins Power Systems, LLC, 890 Zerega Avenue, Bronx, NY 10473. Contact Mr. Ed Cheung, 718-892-2400.

B. Substitute manufacturers shall provide a complete statement of compliance indicating meeting or deviating from these specifications.

2.02 PORTABLE GENERATOR CONVERSION

A. Major Components

1. Take delivery of and install generator set.

2. Provide and install rubber anti-vibration mount isolators at all genset mounting points.

B. Z-CUBE® Container

1. Provide a like-new (one-tripper) 40' high cube ISO shipping container

a. Includes fabrication and installation of 1/4" thick reinforcing C-channel.

b. Top corner castings will be covered to prevent lifting from top.

C. Coatings / Rust Prevention

1. Sandblast Z-CUBE® Container to a minimum of SSPC SP6 in preparation of paint.

2. Z-C UBE® Container will include Girtz Standard paint.

   a. Color: TBD

3. Sandblast fuel tank to a minimum of SSPC SP6 in preparation of paint.

4. Fuel tank will be painted to be compliant to corrosive environment per Girtz Standard

D. Louvers - Air Intake/Exhaust

1. Fabricate and install rain resistant air intake louvers adequately sized for engine aspiration and cooling.

2. Fabricate and install duct silencers in the side of the enclosure for sound abatement.

3. Fabricate and install rain resistant air intake louvers located in rear doors for engine aspiration and cooling.

4. Provide and install an aluminum gravity damper to mount to the genset-mounted radiator to keep cold air and debris out when the unit is not running.

5. Fabricate and install duct silencers on the interior of the rear doors for sound abatement.

6. Fabricate and install a screened frame in the roof of the container adequately sized for radiator and exhaust air to exit the unit.

   a. Adequately sized to allow radiator to be removed through the roof.

   b. Removable bolt-on design.

   c. Powder coated for corrosion protection.

E. Sound Attenuation

1. 40' Z-CUBE® unit to be sound attenuated using 4" thick mineral wool and perforated aluminum.

F. Floor Treatment

1. Floor will be left unchanged and painted same as container.

G. Interior Walls

1. Fabricate and install interior blank-off wall around radiator.

H. Personnel Doors

1. Fabricate and install (3) composite personnel wood core door(s) with heavy-duty, lock-bar latches with escape mechanism.

I. Service Access

1. Provide and weld in (1) roof access ladder(s) for high cube.

2. Fabricate and install (1) radiator fill door(s).

    a. Roof-Mounted.

3. Fabricate and install a bolt-on DPF access panel.

4. Fabricate and install a bolt-on SCR access panel.

5. Fabricate and install bolt-in connection bulkhead for DEF supply and DEF power.

6. Fabricate and install bolt-in, 4-port fluid connection bulkhead in sidewall of container to house fuel supply/return, oil drain, coolant drain connections.

J. Customer Connection

1. Fabricate and install (1) top-hinged load cable access door(s) to attach the load cables to the switchgear busbar.

    a. Side wall-mounted.

    b. Padlockable slamlatch hardware.

    c. Shore power connection.

    d. Load cable access.

K. Switchgear

1. 450kW Cummins 480/208VAC Paralleling Switchgear.

    a. Switchgear cabinet designed for use with (1) Cummins 450kW genset equipped with PCC 3.3 paralleling capable genset controller. Switchgear cabinet intended to provide the following main features/devices:

        1) Switchgear Cabinet:

            a) Cabinet-mounted between doghouse and side wall of enclosure.

            b) Hinged front door and removable side and top panels.

            c) Powder coated for corrosion protection.

            d) Includes door-mounted indicator lamps.

        2) Dual Voltage Linkboard:

            a) Mounted inside switchgear cabinet.

            b) Provides two connection configurations:

                - Low wye (208V) mode
                - High wye (480V) mode

            c) Configuration changed by physically moving linkboard up/down.

d) Linkboard position indicated by door-mounted lamps.

3) Customer Connection Panel:

a) Located on side of switchgear cabinet, accessible from outside of enclosure.

b) Tin-plated aluminum busbar used throughout.

c) Bolt-on camlock connectors available upon request.

d) Shore power terminal blocks (240/120V).

e) Shore power load distribution done in separate house power distribution panel.

4) Overcurrent Protection:

a) (1) 1600A fixed mount, electrically operated circuit breaker.

b) LI trip units.

c) 24VDC charge, trip and close.

d) 24VDC undervoltage release.

5) Provide and ship loose (1) 50' paralleling cable with Ndaga plugs.

6) Genset (or Equipment) Rated Conductors

a) Provide and install cable tray from the generator to the switchgear cabinet.

b) Provide and install cable.

c) Provide and install cable lugs.

L. House Electrical

1. Provide and install 100A house electrical distribution.

2. Connect generator jacket water heater to electrical distribution.

3. Provide and install (4) interior 24VDC LED light(s) all controlled by (1) 0-60 minute timer.

4. Provide and install DC breaker.

5. Provide and install (2) emergency stop box(es) on the exterior of the unit.

6. Provide and install conduit and wiring for lighting, outlets, etc.

7. Provide and weld unistrut to the walls of the container for mounting various items.

M. Battery System

1. Provide and install battery system cables.
2. Provide and install (2) engine starting batteries.
    a. 12VDC 1400CCA.
    b. 8D, lead acid, deep cycle (shipped wet).
    c. Connected series/parallel to create a 24VDC system.
3. Fabricate and install (2) battery mounting bracket(s).
    a. Step-Style
    b. Powder coated for corrosion protection
4. Provide and install battery disconnect switch and mounting bracket.
5. Provide and install 10A battery charger.

N. Fuel System

1. Provide and install a 1,600 gallon double-wall, diesel fuel trapezoidal tank.
    a. UL-142 Listed Secondary Containment.
    b. Carbon steel construction.
    c. Main and secondary tank emergency vent(s).
    d. Main tank atmospheric vent.
    e. Main and secondary tank drain(s).
    f. Exterior Paint (Color: TBD).
    g. Electronic switch for secondary leak detection.
    h. High capacity fuel supply with pick-up tube.
    i. High capacity fuel return.
2. Provide and install a dual element fuel/water separation filter.
    a. Racor 75/1000 FHX.
    b. 180/360 GPH (681/1363 LPH).
    c. 22"H x 18.75"W x 11"D.
    d. 7/8"-14 UNF Port.
    e. Includes drip pan and mounting bracket.

3. Provide and install fuel supply and return piping between the container side wall and the generator.

4. Provide and install fuel supply and return piping between the genset and the fuel tank.

O. Fuel Monitoring and Controls

1. Provide and install mechanical fuel level gauge in tank.

2. Fabricate and install lockable fueling connection panel.

a. 4" fuel fill.

b. Fuel level and overfill alarm-mounting provisions.

c. Bolt-In design.

3. Provide and install analog fuel level probe.

a. Provides 4-20mA output signal.

b. NPT Mounting, Sender length based on application.

4. Provide and install external analog fuel level monitoring and alarm system with digital display, including:

a. Digital display with fuel level indication in remaining gallons.

b. Power and Rupture 12mm LED light indication.

c. Resolution of display is 1 gallon.

1) Accuracy of fuel level will depend on style of fuel tank.

d. Designed to indicate overfill condition via float switch.

e. Display is intended to be switched 'on' before fueling.

f. Visual "overfill" LED will be illuminated and the Audible 68dB~80dB alarm will sound until overfill condition is resolved or panel is switched 'off'.

5. Provide and install fuel hose between the fuel tank and the fuel fill.

P. Engine Oil

1. Provide and install piping for oil drain to the exterior of the unit with shut off valves

Q. Cooling System

1. Provide and install piping for glycol drain to the exterior of the unit with shut off valves

R. Spill Containment

1. The fuel tank will be of double-wall construction and will be equipped with a fuel-in-basin alarm.

2. A liquid tight spill pan will be constructed and placed under the genset to capture engine fluids.

    a) Includes guide rails mounted to container to ensure correct placement during installation.

S. Tier 4 Exhaust System

1. Install customer supplied Tier 4 SCR system.

    a. Girtz to fabricate and install support/mounting structure.

    b. All isolators and other components must be supplied by customer.

2. Install customer supplied Tier 4 DPF system.

    a. Girtz to fabricate and install support/mounting structure.

    b. All isolators and other components must be supplied by customer.

3. Install customer supplied Tier 4 mixing section.

4. Install customer supplied dosing & control cabinet.

    a. All isolators and other components must be supplied by customer.

5. Install customer supplied 65 gallon DEF tank and level indicator.

6. Fabricate and install exterior DEF fill access with locking door.

7. Provide and install tubing for DEF.

    a. Includes tubing from tank to dosing cabinet to SCR system.

8. Provide system of heating all DEF lines.

9. Fabricate and ship loose an exhaust stack with testing ports.

    a. Support/mounting structure included.

    b. Roof-mounted for when Tier 4 compliance testing is required.

10. Provide and install exhaust transition pipe.

    a. Piping between engine and DPF.

    b. Piping between mixing section and SCR.

11. Provide and install exhaust rain cap(s).

12. Provide and install 90 degree exhaust elbow.

13. Provide and install stainless steel exhaust bellows.

14. Provide and install 1" thick exhaust thermal wraps located on Girtz supplied piping.

    a. Thermal wraps for the DPF, SCR, and mixing section to be provided by customer.

T. Fire Detection/Suppression

1. Provide and mount (2) 20lb fire extinguisher(s) and bracket(s).

    a. UL Rating 10A, 120B, C.

    b. USCG Steel Wall Type Bracket.

U. COMPLETE ASSEMBLY Testing

1. Perform basic AC/DC functionality checks. Prove ancillary devices are functional (fuel display, etc.).

2. Girtz Power System Test. Intent of this test is to get the power system up and running to prove operation and check for any problems. Includes the following:

    a. Position finished unit at Girtz test area.

    b. Completely fuel and de-fuel tank to prove fuel level indication.

    c. Leave sufficient fuel in tank for test purposes.

    d. Provide shore power to unit and prove all electrical house loads (jacket water heaters, battery charger, etc.).

    e. Connect generator output to Girtz load bank.

    f. Prime fuel system, start unit and apply load in 25% steps up to 100%. Record test data.

    g. Do thorough examination throughout process to:

        1) Verify and remedy any fuel or fluid leaks.

        2) Verify proper air flow through unit.

        3) Verify proper exhaust system operation.

        4) Verify proper genset operation – address fault codes as much as possible.

    h. Witness testing not included, this is a functional load/system test only.

    i. Girtz load bank testing is limited to:

        1) Resistive loads up to 4MW @ 480V, 2MW @ 4160V

        2) Reactive loads up to 500kW @ 0.8pf

        3) Systems made up of 4160VAC, 600VAC, 480VAC, or 240VAC

j. Shore power connection limited to 480VAC.

k. Load bank testing and/or voltages beyond these limits is not included, but can be quoted upon request

3. Girtz Basic Tier 4 System Test. Intent of this test is to get the Tier 4 system up and running to prove operation and check for any problems. Includes the following:

a. Completely fill DEF tank checking for any leaks or plumbing issues.

b. Leave sufficient DEF in tank for test purposes.

c. While system is operating check to ensure no leaks occur in the DEF lines.

d. Prime DEF system, start unit and apply 100% load.

e. Do thorough examination throughout process to:

1) Verify and remedy any fluid leaks in the Tier 4 system.

f. Customer must provide tech support for troubleshooting errors in dosing cabinet.

4. Fuel for testing.

5. DEF for testing.

V. Decals

1. Provide and install standard sized decals.

2. Provide and apply notification and safety decals.

W. Miscellaneous

1. Provide and install a set of 2 load stabilizing jacks for chassis.

a. Painted safety yellow.

2. Provide (1) rigid ladder(s) with removable handrail for access into the unit while on a chassis.

a. Aluminum, 5-Step.

b. Portable, non-self supporting.

c. 10 in rise x 7 in tread x 23 in wide.

3. Fabricate and install (1) engine manual literature box.

a. Powder coated for corrosion protection.

X. Engineering Services and Drawings

1. Provide submittal drawings for customer approval prior to build.

2. Literature package provided upon completion of final testing includes:
   a. General layout drawings.

   b. Wiring diagram for electrical systems.

   c. Individual component manuals.

   d. Girtz test report.

   e. Any Certificates of Origin.

   f. Provided electronically only.

Y. Chassis and Accessories

1. Option 20625-01: Provide a 40’ ISO container tri-axle chassis that is Air Ride equipped

   a. Landing gear rated for 50,000 lbs.

PART 3 EXECUTION

3.01 ACCEPTANCE

A. Equipment shall be initially started and operated by representatives of the manufacturer.

B. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to final testing of the system.

3.02 TRAINING

A. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than two (2) four (4) hours sessions in duration and the class size shall be limited to five (5) persons. Training date shall be coordinated with the facility owner.

3.03 DEMONSTRATION

A. Provide systems demonstration. Electrical Contractor shall provide fuel for testing and shall fill tank complete after all testing is done and before turning over to Owner.

B. Simulate power outage by interrupting normal source and demonstrate that system operates to provide standby power.

END OF SECTION

SECTION 16900

AUXILIARY CONTROLS AND RELAYS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pushbutton.

B. Selector switches.

C. Indicating pilot lights.

D. Contact blocks.

E. Control power transformers.

F. Fuse blocks.

G. Limit switches.

H. Time delay relays.

I. Relays.

J. Intrinsically safe barriers.

K. Liquid level sensors (floats).

1.02 REFERENCES

NEMA ICS 1	General Standards for Industrial Control Systems
NEMA ICS 2	Standards for Industrial Control Devices, Controllers and Assemblies
NEMA ICS 6	Enclosures for Industrial Controls and Systems
NEMA ST 1	Standard for Specialty Transformers (Except General Purpose Type)

1.03 SUBMITTALS

A. Submit shop drawings under provisions of Section 01300, Submittals.

B. Submit shop drawings to NEMA ICS 1 indicating control panel layouts, wiring connections and diagrams, dimensions, support points.

C. Submit product data under provisions of Section 01300, Submittals.

D. Submit product data for each component specified. The submittal shall be included as part of the system in which the component is specified.

E. Submit manufacturer’s installation instructions under provisions of Section 01300, Submittals.

F. Submit samples as requested by the Engineer.

1.04 PROJECT RECORD DOCUMENTS

A. Submit record documents under provisions of Section 01700, Closeout and Record Documents.

B. Accurately record actual locations of control equipment. Revise diagrams included in Drawings to reflect actual control device connections.

1.05 OPERATION AND MAINTENANCE DATA

A. Submit operation data under provisions of Section 01700, Closeout and Record Documents.

B. Include instructions for adjusting and resetting time delay relays, timers, and counters.

C. Submit maintenance data under provisions of Section 01700, Closeout and Record Documents.

D. Include recommended preventive maintenance procedures and materials.

1.06 QUALIFICATIONS

A. Manufacturer - Company specializing in manufacturing the products specified in this section with minimum 10 years' documented experience.

PART 2 PRODUCTS

2.01 PILOT DEVICES

A. General

1. Pilot devices shall include indicating light, pushbuttons, and selector switches.

2. Heavy-duty, industrial type, construction.

3. Area Classification

a. Non-Classified Area Device Rating - NEMA 13 oil-tight.

b. Wet Area or Exterior Device Rating - NEMA 4 and NEMA 13 oil-tight and watertight.

c. Corrosive Area Device Rating - NEMA 4X, non-metallic.

d. Hazardous Area Device Rating - NEMA 7, explosionproof.

4. Provide extra large nameplates in accordance with Section 16075, Electrical Identification, for all door or enclosure front-mounted devices.

5. Controls and relays shall be by one manufacturer wherever possible.

6. Provide enclosure for field mounted devices and individual controls.

7. 30-millimeter diameter.

8. Retaining ring and boot type.

B. Pushbuttons and Selector Switches (PB) and (SEL SW)

1. Lockout feature as indicated.

2. Color - Red for stop or terminate function; black for all others.

3. Operators

a. Provide “gloved hand” knobs for selector switches.

b. Provide “mushroom head” button on emergency stop pushbuttons.

4. Stackable contact blocks.

5. Devices shall be either momentary, maintained, spring return, push-pull, or other operational types as shown or otherwise specified.

6. Manufacturer NEMA 4 and 13 Oil and Water Tight - General Electric, Square D Type K.

7. Manufacturer NEMA 4X, Non-Metallic - Allen Bradley Type 800H, Square D Type SK.

8. Manufacturer NEMA 7, Explosionproof - Allen Bradley Type 800H, Crouse-Hinds Type EFS and Type EMP for panel-mounted units.

C. Indicating Pilot Lights (IL)

1. Glass or plastic lens.

2. 120-volt LED type.

3. Push-to-test type. When six or more pilot lights are used in control panels, a single lamp test switch can be used in lieu of all lamps being push-to-test.

4. Lens color shall be as follows:

Function	Color
Motor Running	Green
Motor Stopped	Red
Malfunction	Amber
Ready	White or Green

5. Manufacturers - General Electric, Square D, Crouse-Hinds, or Allen-Bradley.

2.02 CONTACT BLOCKS

A. Molded of an amorphous transparent polyamid material with high impact resistance and resistant to carbon tracking.

B. Contacts - Double break silver type rated at 10 amp at 120 VAC continuous.

2.03 CONTROL POWER TRANSFORMER (CPT)

A. Standard industrial control type, VA size as required for the powered load.

B. Dual voltage primary, with 120V ac, single phase secondary. All primary connections fused; size as required for the transformer.

C. Secondary control fuse with capacity for the control circuit indicated.

D. DIN-rail-mounted type in control panels.

E. Manufacturer - Square D, General Electric.

2.04 FUSE BLOCKS

A. General purpose Class H, K, and R phenolic fuse block for dual-element cartridge fuses.

B. DIN-rail mounted in control panels.

C. Manufacturer - Buchanan or equal.

2.05 LIMIT SWITCHES (LS)

A. Contacts - Silver-to-silver snap-acting where practicable and in all cases where the motion is slow.

B. Switches - Operated by levers, plungers, or pushrods, depending on the application.

C. Rollers - Provided where excessive wear due to a sliding action would result.

D. Manufacturer - General Electric Class CR215G, Square D Class 9007 Type C.

2.06 ELAPSED TIME METERS (ETM)

A. Minimum six-digit, non-resettable hour meter, panel mounted.

B. For operation on 120 volts.

C. Manufacturer - General Electric.

2.07 TIME DELAY RELAYS (TR)

A. Solid-state type with calibrated dial head or dip switch adjustment, encapsulated coil, snap-action switch assembly of number of poles indicated.

B. “On-Delay,” “Off-Delay,” or “On-Off Delay” dual head type as indicated; timing range intervals as shown or specified.

C. Bases shall have captive screws for locking fork solderless connectors, single tier design, with relay retainer clips.

D. Dust-tight construction.

E. Provide auxiliary contacts where indicated.

F. Contacts rated 10 amps resistive at 120 VAC.

G. Manufacturer - Diversified Electronics Series “TD;” Square D, Type JCK; Timemark 300 Series.

2.08 GENERAL PURPOSE CONTROL RELAYS (CR)

A. Units shall be plug-in type.

B. Only for use in manufactured or custom-built control panels.

C. Number of poles and arrangement as shown or specified.

D. Contacts

1. Shall be rated 10 amps at 240 volts AC.

2. Material shall be silver cadmium oxide.

E. Coils shall be rated continuous duty.

F. Sockets

1. Supply with relay retainer clip.

2. Terminal connections with captive screw to accept locking fork solderless connectors.

3. Single tier design.

G. Manufacturers - Square D Company Class 8501 Type K relay and Type NR socket; Potter-Brumfield; or equal.

2.09 INDUSTRIAL CONTROL RELAYS (CR)

A. Industrial machine tool type.

B. Use - Shall be used to control equipment with power requirements, such as solenoid valves.

C. Contacts

1. Double break field convertible.

2. Rated 10 amps at 600 volts AC.

3. Rated 5 amps at 250 volts DC.

D. Coil shall be encapsulated, continuously rated of the voltage rating indicated on the plans.

E. Number of poles as indicated on Contract Drawings, but not less than four.

F. Holding and Operating Mechanism

1. Electrically held, electrically operated, General Electric Company CR-120A; Square D Company Class 8501, Type X; or equal.

2. Mechanically held/electrically held relay with mechanically-held attachment.

3. Time Delay - Pneumatic timer attachment for electrically-held delay; “on delay” or “off delay” as indicated on plans.

2.10 INTRINSICALLY-SAFE BARRIERS

A. Power supply, bistable input amplifier, intrinsically-safe for connections to passive devices located in hazardous areas.

B. Relay Output Stage - LED indicator type.

C. FM approved. Manufacturers: Pepperi & Fuchs WE Series, Square D, Class 8501.

2.11 LIQUID LEVEL SENSORS (FLOATS)

A. Contacts - A normally open, normally closed mechanical micro switch SPDT (single break) totally encapsulated in epoxy or polyurethane. Mercury switches are not acceptable.

B. Cable - Type STO or SJO cable of sufficient length (65 feet minimum length) to reach the first junction box with minimum conductor size of 19 AWG.

C. Sufficient excess cable shall be provided with each liquid level sensor to adjust its vertical position 1 foot± of its original setting.

D. Provide stainless steel mounting brackets to support all float switches.

E. Manufacturer - Flygt Model ENM-10 or equal.

2.12 MAGNETIC DOOR CONTACTS

A. Device shall provide a normally open & a normally closed contact loop output for alarm monitoring.

B. The mechanism shall be adjustable so that the operating gap between faces of the switch housing and the magnet housing may be adjusted up to 0.3 in. to accommodate installation variances.

C. Manufacturer - UTC 2202 series switch or approved equal.

2.13 TEMPERATURE MONITOR

A. Device shall mechanical temperature monitor with SPDT, open/close on rise with steel enclosure. Contacts rated 22A, 277VAC.

B. Temperature range for alarm use shall be 20 to 110°F

C. Manufacturer – Johnson Controls model A19BBC-2C or approved equal.

PART 3 EXECUTION

3.01 GENERAL

A. Mount all individual controls in a suitable enclosure.

B. Identify all auxiliary controls per Section 16075, Electrical Identification.

C. General purpose control relays shall be used in manufactured or custom-built control panels. The Contractor shall use control relays as described in Article 2.09 to control equipment with power requirements, such as solenoid valves.

3.02 CONTROL POWER TRANSFORMER

A. Provide individual control power transformers for each control circuit.

B. Size as required by control circuit.

3.03 FUSE BLOCKS

A. Size as indicated on Drawings or as required.

3.04 LIMIT SWITCHES

A. Limit switches shall be provided where specified and where it is required to convert a mechanical motion into the control of an electric circuit.

3.05 PUSHBUTTONS AND SELECTOR SWITCHES

A. Units shall be back-mounted wherever possible.

3.06 FLOATS

A. Mount floats per the installation notes or details as shown on the Drawings.

END OF SECTION

SECTION 17000

INSTRUMENTATION

PART 1 GENERAL

1.01. SECTION INCLUDES

A. This section includes the general work description and requirements for instrumentation provided by this contract.

1.02. GENERAL REQUIREMENTS

A. It is a requirement of this specification that all Division 17 specifications be provided by a single supplier. This supplier shall have total responsibility for the entire system performance and compatibility of this section, as well as all other Division 17 specifications.

1.03. REFERENCES

A. NEMA ICS 1 - General Standards for Industrial Control and Systems.

B. NEMA ICS 3 - Industrial Systems.

C. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

D. NFPA 70 - National Electrical Code (NEC).

E. NFPA 79 – NEC (Labeling).

F. ISA - Standards 5.1 and 5.4.

G. IEC 1131-3 – Programming Standards.

1.04. SHOP DRAWINGS

A. All Division 17 specifications shall be submitted in one shop drawing. Requirements of individual specification sections shall be contained within a single section in the shop drawing submittal. Indicate individual specification sections with a protruding tab. Submit material in the format and order as described in paragraph 1.05.B.3.

B. Shop Drawing Submittal Format

1. Shop drawings shall be submitted in electronic format (i.e. pdf).

2. Title page shall include job name, EDR job number, Contractor(s) job number(s), date, “Division 17 Shop Drawing”, Contractor and supplier(s) names, addresses, contact persons, and contact numbers.

3. Contents shall be organized accordingly.

a. Table of Contents – List of each section. Provide protruding tabs labeled with the pertinent heading for each section listed in the Table of Contents.

b. For each Division 17 specification section, provide the following within the respective sections:

1) Table of Conformance.

2) Training itinerary.

3) Bill of Materials (BOM) for installed equipment, BOM for spare parts, and BOM for extra materials. Each BOM shall be grouped and identified separately.

4) Equipment information satisfying specifications. Provide protruding tabs for each piece of equipment. Label each tab with the equipment manufacturer.

c. AutoCAD Drawings – Include title block, border, page numbers, and supplier job number. CD containing all Division 17 AutoCAD 2014, or higher, *.dwg files. Sheet/drawing titles shall utilize three lines in the title block and are subject to approval, and instructed change, by the Engineer.

4. AutoCAD drawings shall be 11-inch by 17-inch.

5. Shop drawings not containing the appropriate information or format will be returned without further review.

C. Shop Drawing Submittal Contents - The following requirements pertain to all of Division 17 specifications and are intended to complement the requirements of Section 01640. Refer to individual Division 17 specifications for further requirements.

1. Include a complete Table of Conformance to each paragraph, or part, of Part II in the respective specification. Use a Microsoft Word 2003 table format with four columns labeled as “Specification Section”, “Equipment Manufacturer”, “Equipment Model”, “Compliant (Y/N). If No, specify”. As a minimum, identify equipment compliance in the “Compliant (Y/N). If No, specify” column for each article (i.e., 2.02), letter heading (i.e., A, B, C), and each number heading (i.e., 1, 2, 3). For exceptions or deviations, include a narrative description as to how the deviation or exception can benefit the system over that which is specified.

2. Training Itinerary – Detailed itinerary for the training to be provided in Microsoft Word 2003 table format. Itemize the day of training (“Day 1,” “Day 2,” or “Hour 1,” “Hour 2,” etc.) and the lessons to be taught during that period. Further discuss the equipment to be used during training and the proposed location of training for that day. Account for all days of specified training. Provide one training itinerary sheet for each training period. At the top of each sheet provide a header description of the training session and duration of training to be provided.

3. Detailed Bill of Materials in Microsoft Word 2013 table format, or Excel 2003, identifying component name, manufacturer, model number, and quantity supplied. Typical Bills of Materials are not acceptable.

4. Descriptive lists of spare parts and extra materials provided in the same tabular format as the Bill of Materials. Lists shall be exclusive to the spare parts and extra materials requested by the specification section, hence separate from the Bill of Materials for installed equipment. Lists shall be intuitive and specifically created for this project.

5. For individual equipment, submit information satisfying every item discussed in Part II of that specification section. Additionally, submit on all supporting accessories including, but not limited to, terminal blocks, surge and lightning suppression, UPSs, fuses, and cabling.

6. AutoCAD 2014 or Higher Drawings - Provide loop and block diagrams. Symbols used and nomenclature shall be in accordance to ISA Standard 5.4. Diagrams shall be specific to the equipment submitted with the options and features specified or otherwise provided. The inclusion of options not specified or provided is unacceptable. Terminal points depicted shall be the terminal points provided with identical terminal point designations as the supplied equipment. Illustrate all available terminals that are not utilized.

7. Proposed nameplate wording. Scaled illustrations for each nameplate provided.

8. Manufacturer's literature and Web site printouts are independent of the above requests for information and, hence do not satisfy the above shop drawing requirements. All catalog cuts, Web site printouts, manufacturer's specifications, and drawings shall be clearly marked to allow identification of the specific products used. Cross-out all options and functions not supplied with the equipment.

9. Electrical power requirements, connection requirements, interconnecting cabling, and environmental limitations/restrictions.

10. Dimensions and weights of the equipment with the specified options.

1.05. OPERATION AND MAINTENANCE DATA

A. The following requirements pertain to all of Division 17 specifications and are intended to complement the requirements of Section 01640 as well as individual Division 17 specifications.

B. Submit under provisions of Sections 01640.

C. Provide complete sets electronic formatted Operation and Maintenance (O&M) Manuals. In addition to "As-Built" system drawings, the manuals shall include internal wiring diagrams and operating and maintenance literature for all components provided under Division 17. Utilize a Table of Contents listing major headings tabs and sub-major headings tabs. Provide tabs labeled with the pertinent heading for each item listed in the Table of Contents. Otherwise, utilize the same format as specified for shop drawing submittals.

D. Submitted literature shall be in sufficient detail to facilitate the operation, removal, installation, programming and configuration, adjustment, calibration, testing, and maintenance of each component and/or instrument. Indicate application conditions and limitations of use stipulated by the product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

E. Provide a separate Section for the configuration settings for each instrument provided in Division 17. Provide a Table of Contents with tabs for each instrument. Label each with the equipment name and equipment designation. Indicate the value of all configuration parameters and setpoints, including those that are not utilized in the equipment's field configuration.

F. Contractor shall review all submitted literature and cross out all options, functions, warranties, etc. not part of the supplied equipment.

1.06. PROJECT RECORD DOCUMENTS

A. The following requirements pertain to all of Division 17 specifications and are intended to complement the requirements of Section 01640 as well as individual Division 17 specifications.

B. Submit under provisions of Sections 01640.

C. Record actual locations of controller cabinets and input and output devices connected to system. Include interconnection wiring and cabling information, and terminal block layouts in controller cabinets.

1.07. DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 01640.

B. Accept products on site in factory containers unless system is completely integrated into a pre-manufactured panel that has been factory tested. Inspect for damage.

C. Store products in clean, dry area; maintain temperature to NEMA ICS 1 requirements.

1.08. COORDINATION

A. Refer to Contract Drawings for designations and verify with Owner.

B. Coordinate demonstration to Owner with the Contractor and the Owner.

1.09. TRAINING

A. Contractor shall video-record all training sessions. Provide a video recording of each training session on a single DVD. Provide two duplicate DVDs for each training session and distribute one copy to the Owner and one to the Engineer. Provide computer-generated adhesive labels on each DVD. Label each DVD with the training session description, date training occurred, attendees, trainer, contact information, the equipment covered during the training session, and the project title.

B. Engineer will review their copy for video quality including, but not limited to, picture quality, use of camera angles, and sound recording quality. Video must be clearly audible. If the Engineer deems the video or audio quality as poor, the Contractor shall conduct the training session again (with original attendees present) and re-record the session at no additional cost to the Owner.

C. Provide a DVD case to hold all training tapes provided for Division 17 specifications.

PART 2 PRODUCTS

2.01. ACCESSORIES

A. Nameplates

1. Laminated plastic nameplates shall be provided for each instrument in Division 17.

2. Nameplates shall have 5/16-inch high capital, white letters on black background machine engraved. Hang nameplates from process-mounted instruments via metallic chains. Nameplates shall be hung within 12 inches of the equipment.

3. Final wording on nameplate shall be submitted during the shop drawing phase and approved by the Engineer.

4. Nameplates shall be uniformly mounted and of identical form-factor for all equipment that nameplates are provided. Once a nameplate format has been selected, the format shall be utilized for all equipment throughout, thereby excluding providing original equipment manufacturer (OEM) nameplates.

5. Where wire labeling is not conducive to nameplate tagging as specified above, such as in MCC compartments or inside the programmable logic controller (PLC) enclosure, provide wire labeling on computer printed, adhesive tape, and wraparound wiring. Printing that is capable of being rubbed off the wire label is not acceptable.

6. Text on nameplates shall be as follows.

   a. First Line – Equipment name. Equipment name shall be as listed on the Contract Drawings and PLC input/output (I/O) lists.

   b. Second Line – Equipment designation. Designation shall be in accordance with ISA Standards 5.1 and 5.4 as listed in the PLC I/O lists and on the Contract Drawings.

   c. Third Line – Wiring destination. Indicate the destination of the wiring (i.e. PLC-CB, PLC-GRB, MCC-1, etc.).

B. Lightning and Surge Protection

1. Provide lightning and surge protection on the power supply of each instrument provided under Division 17.

2. Provide lightning and surge protection on all analog input and output signal circuits that pass out of doors or are terminated to metallic piping that passes out of doors.

3. Surge protection devices mounted on the analog output signal wiring of field-mounted transmitters shall be conduit-mounted utilizing a common chamber, three element, gas tube and clamp incoming transients to a level acceptable to the transmitter it is protecting. Manufacturer shall be Joslyn, Model 1669-01, or equal.

4. Surge protection devices protecting analog circuits entering the PLC enclosure shall be din-rail mounted with removable terminal blocks on each side of the device with no interruption of the incoming signal by unplugging the surge protection device. Device shall possess the capability of discharging 1000 Amps evaluated on an 8x20-microsecond waveform. Device shall have an LED to indicate the unit is functioning properly. Surge protection device shall be manufactured by M-System Co, Model MDP-24-1, or equal.

C. Wiring/Conduit/Mounting

D. The Contractor shall provide all power wiring and conduit to each instrument specified in Division 17.

1. The Contractor shall provide all signal wiring and conduit from the PLC to new and existing equipment as specified in the I/O list of the Contract Documents.

2. The Contractor shall provide all other wiring integral to supplied equipment to achieve the specified system performance as discussed individual Division 17 sections.

3. The Contractor shall mount all equipment specified in Division 17 in locations discussed/shown in the Contract Documents.

PART 3 EXECUTION

3.01. EQUIPMENT MOUNTING

A. All mounted equipment shall have sufficient clearance from other provided or existing obstructions (including walls, pipes, conduit, or other instruments) to facilitate removal, adjustment, inspection, and calibration of the installed device. Any device that is mounted without sufficient clearance to perform these functions with standard, manufacturer recommended tools shall be removed and remounted at no additional cost to the Owner.

B. Rotate equipment heads as directed by the Engineer in the punch list for final completion.

END OF SECTION

SECTION 17095

CUSTOM CONTROL PANELS AND INTEGRATION

PART 1 GENERAL

1.01 DESCRIPTION:

A. It is the intent that the Contractor will work with a system integrator to successfully fulfill the requirements herein and shown on the Contract Drawings to provide a complete and operable control system (fully integrated) with the intent specified and shown on the Contract Drawings.

1. Note, this section is part of the General Construction Contract.

B. System integrator referenced throughout this specification is referring to the panel provider.

C. Control panels specified herein are to be provided as a packaged system with variable frequency drives and vertical centrifugal pumps.

1.02 SECTION INCLUDES

A. Union Hill Pump Control Panel (PLC-UH)

1. Fully redundant control system

B. Tallman Pump Control Panel (PLC-TA)

1. Fully redundant control system

C. Bubbler Wetwell Level Detection Systems

D. Float Switches

E. Magnetic Flow Meters

F. Pressure Switches

G. Auto-Dialers

H. Software

I. Integration Services, Programming, and Screen Development

J. Commissioning, Startup Services, & Training

K. I/O Table

1.03 REFERENCE STANDARDS

A. All control systems specified herein shall be provided in accordance with the latest additions of the NEC and IEC.

B. All wiring shall be in complete conformance with the National Electrical Code, State, local and NEMA electrical standards. All incoming and outgoing wires shall be connected to numbered terminal blocks and all wiring neatly tied and fastened to chassis as required.

C. All control panels shall be UL 508A listed or UL 698A listed, whichever may be applicable. The UL 508A/698A “sticker” shall be clearly displayed in the appropriate location within the panel. Third party substitutions of UL 508A/698A listed equipment shall be strictly prohibited.

D. All equipment and installations shall satisfy applicable Federal, State, and local codes.

E. Furnish products listed and classified by Underwriters Laboratories (UL), CSA, or FM approval as suitable for purpose specified and indicated.

F. Auxiliary and accessory devices necessary for system operation or performance, such as transducers, relays, signal amplifiers, intrinsic safety barriers, signal isolators, software, and drivers to interface with existing equipment or equipment provided by others under other Sections of these specifications, shall be included whether they are shown on the Drawings or not.

G. Use the equipment, instrument, and loop numbering scheme shown on the Drawings and specifications in the development of the submittals. Do not deviate from or modify the numbering scheme without the Engineer's approval.

1.04 RELATED SECTIONS

A. Contractor to coordinate sequence of operation with the engineer and owner.

1. Contractor to include two (2) 4-hour meetings with the engineer and owner to discuss/finalize sequence of operation in which control system is to be programmed for.

a. Meetings to take place at the project site.

B. Section 11306 – Vertical Centrifugal Pumps

C. Section 16480 – Variable Frequency Drives

D. All Division 16 Specifications

1.05 SUBMITTALS

A. The Systems Integrator shall for review, provide to the contractor, for submission to the engineer, three (3) hardcopy sets and one (1) electronic copy (USB) of the following documentation:

1. Written Sequence of Control System Operation (coordinate as required with the engineer and owner).

2. Electrical and Mechanical Schematic Drawings.

3. Bill of Materials.

4. Vendor Data Sheets.

5. System Warranty (see below).

6. System Integrator Qualifications (see below).

7. Control Panel Heat Dissipation Calculations

8. Uninterruptable Power Supply sizing calculations.

9. Point to point wiring diagrams. Diagrams to detail terminal block numbers specific to which each signal is to be landed. Refer to article 3.01 for further details/requirements.

B. The Engineer shall have the right to witness the factory tests and inspect any equipment to be furnished under this Section prior to their shipment from the place of manufacture.

C. The Contractor shall make all arrangements and pay for all travel and expenses for up to three people from the Owner and Owner's Engineer to witness the shop tests.

1.06 OPERATIONS AND MAINTENANCE DOCUMENTATION

A. The Systems Integrator shall provide to the contractor three (3) hardcopy sets and one (1) electronic copy (USB) of the following Operations and Maintenance documentation; all documentation shall be neatly bound in 3-ring binders.

1. Final Written sequence of control system operation (coordinate as required with the engineer and owner).

2. As-Installed Electrical and Mechanical Schematic Drawings.

3. Bill of Materials.

4. Vendor Operation, Maintenance and troubleshooting documentation.

5. PLC and OIU program printouts.

6. Back-up Copies of As-installed PLC and OIU programs on CD and USB thumb drive.

7. Point to point wiring diagrams indicating as-built conditions.

1.07 WARRANTY

A. The Systems Integrator shall provide, with the above submittals, a written parts warranty against system failure for twelve (12) months from system startup, not to exceed eighteen (18) months from date of shipment from their factory. This warranty period will, except for human negligence or acts of nature such as lightning, floods, etc., provide for repair or replacement of any defective or failed components, at the project site, and at no cost to others. Warranty to cover all equipment/devices included within this specification herein.

B. Contractor to provide two-year warranty for all instruments specified/provided as part of this section. Warranty to cover the entire instrument including any associated transmitters/controllers, flow tubes, etc... This warranty period will, except for human negligence or acts of nature such as lightning, floods, etc., provide for repair or replacement of any defective or failed components, at the project site, and at no cost to others.

1.08 QUALITY ASSURANCE

A. The Equipment, controls and accessories covered in this specification section constitute a completely integrated system, designed, constructed, programmed, and tested by one Systems Integrator, accountable for its operation and performance. The Systems Integrator shall be selected based on their ability to Engineer, design and manufacture systems of the type herein specified.

B. The Contractor shall submit to the Engineer the name of the System Integrator to whom they propose to award the work. No Systems Integrator will be approved by the Engineer who cannot furnish satisfactory proof of at least five (5) successful installations which in the judgment of the Engineer are of equal or greater complexity to that described herein.

C. The Systems Integrator shall be a reputable firm that has been in the business of providing automated control systems specifically for the water and wastewater treatment industry for a minimum of ten (10) years. Systems Integrators with less than ten (10) years of experience will not be accepted.

D. The Systems Integrator shall have, as a minimum, five (5) full time employees who are experienced in routine and emergency services of the equipment herein specified. The Systems Integrator shall as a minimum provide two (2) direct cell phone numbers in which service personnel can be reached 24hrs, 7 days a week.

E. The System Integrator shall be U.L. approved for manufacturing systems in compliance with UL 508A and/or UL 698A, whichever may be applicable. Each assembly and subassembly of the system shall be listed and labeled as U.L. approved. Systems Integrators who outsource panel fabrication services for the purpose of providing UL labeling will not be accepted.

F. For serviceability reasons the system integrator’s service facility shall be located within 100 miles of the project site. In addition, they must possess factory trained, service staff experienced in routine and emergency service of the type of equipment herein specified who are located within a maximum of two (2) hours of the project site.

G. Control panels shall be fabricated with the following features as a minimum:

1. All sub panel wiring shall be run in plastic wire duct sized with 50% spare space, AC and DC wiring shall be run in separate wire ducts.

2. All power supplies shall be sized for an additional 50% spare ampacity over expected load. Each power supply shall include an AC input fuse and independent output fuses for each device requiring DC power.

3. All field terminations shall be made on compression type terminal blocks labeled according to wire number, separate terminal strips shall be provided for AC and DC signals. A minimum of 20% spare terminals shall be provided.

4. Wiring to door mounted components shall be neatly bundled wiring harnesses protected by plastic spiral wire wrap when crossing door hinge. Wiring harnesses shall have adequate stress loops and be fastened at both sides of hinge crossing.

5. All wiring shall be wire numbered at both ends with plastic Brady type labels.

6. All nameplates shall be engraved on lamacoid material providing black lettering on a white background. Lettering shall be no smaller than 1/8 of an inch in height.

7. Twenty percent spare mounting space is required for future modifications.

H. Products other than the basis of design are subject to compliance with specified requirements and prior approval of the Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.

I. It is a requirement of this specification that all equipment, devices, instruments, and ancillary elements specified herein be furnished by a single supplier. The supplier shall have total responsibility for the equipment and services specified within this section.

1.09 ENVIRONMENTAL CONTROL OF PANELS

A. Panels shall be provided with louvers, sun shields, heat sinks, forced air ventilation, or air conditioning units as required to prevent temperature buildup inside of panel. Internal temperature of all panels shall be regulated to a range of 45 Deg F to 104 Deg F under all conditions. Under no circumstances shall panel cooling or heating equipment compromise the NEMA rating of the panel.

1. Refer to submittal article above and article 2.01(C) below for additional information/requirements.

B. Except for panels mounted with their backs directly adjacent to a wall, louvers shall be in the rear of the panels, top and bottom, and shall be stamped sheet metal construction.

C. For panels mounted with their backs directly adjacent to a wall, louvers shall be on the sides.

D. Forced air ventilation fans, where used, shall provide a positive internal pressure within the panel, and shall be provided with washable or replaceable filters. Fan motors shall operate on 120-volt, 60-Hz power.

E. For panels with internal heat that cannot be adequately dissipated with natural convection and heat sinks, or forced air ventilation, an air conditioner shall be provided.

1.10 DESCRIPTION OF OPERATION

A. Overview

1. The System Integrator shall supply for the contractor’s installation the control panels specified herein. The control panels shall through communications and/or hardwired status and alarm signals monitor/control the operations of process equipment, vendor supplied equipment, and all equipment/devices pertinent to the operations of the pump station (Typical of each station).

2. The Union Hill and Tallman Pump Control Panels shall provide local alarm monitoring by door mounted common alarm lights, momentary pushbutton (for alarm acknowledgement, reset, and horn silence) alarm horn and Operator Interface Unit (OIU).

3. Refer to the Contract Drawings for intent and all equipment/components that control panel are to interface with.

4. Provide all hardware/software, programming, and services as herein specified to provide two (2) completely factory assembled and programmed main pump control panels (Union Hill & Tallman).

5. System integration, programming, screen development, and startup services are to be provided as part of this contract/specification.

6. Provide all required integration services to integrate specified control panels within County existing SCADA network. Contractor to field verify and coordinate efforts closely with the owner.

7. Contractor and Systems Integrator to provide two (2) 4-hour meetings with the owner/engineer at the project site to discuss control panel programming, sequence of operation, and overall intent to ensure specified control panel is programmed properly.

    a. Coordinate meetings with owner/engineer two weeks in advance and prior to submittal documentation submission.

B. Sequence of Operations (Typical of both Union Hill and Tallman)

1. The pump control panels to be PLC based and completely factory programmed as required to provide the following control strategies on each control panel. All control strategies to be fully coordinated with the owner and engineer. Refer to above required meetings to review sequence and finalize programming requirements.

    a. Wetwell Level Monitoring (typical of two wetwells):

        1) Primary wetwell level detection is to be by means of a bubbler system. Since the wetwell is dual chamber, there will be two (2) independent bubbler systems described below (one per chamber). In addition to the primary wetwell level detection systems there will be a high level float in each chamber of the wetwell for alarming purposes.

            a) Bubbler System – wetwell level shall be measured by a pressure-to-current (P/I) transmitter. Major system components shall consist of the P/I transmitter, low pressure air supply, and an air-line extending into and terminating near the bottom of each wetwell chamber. The air supply shall continuously purge the airline. P/I transmitter output shall be 4-20mA DC proportional to wetwell level and shall be connected to the control panel PLC through an analog input. The control panels shall utilize this signal for control, monitoring, trending, and alarming. Ancillary bubbler system components shall include, but not be limited to, the following: two (2) air compressors, one (1) air flow indicator, air pump selector switch, 3/8” & 1/2" air piping, and a 3” PVC air bell for installation within each chamber of the wetwell.

            b) High Level Float – A single high level float switch to be installed above wetwell grating for alarming purposes. As the level rises to the high level float a signal is to be relayed to the control panel and an alarm process initiated.

    b. Level Control Mode Selection:

        1) A level control mode selection (Primary Bubbler / auto / Secondary Bubbler) switch to be provided on each control panel door. Each mode to operate as follows:

a) Primary Bubbler – control panel system logic provides constant level control of wetwell level by use of associated pump VFDs as described below. Control mode remains in primary bubbler level mode regardless of wetwell level readings.

b) Auto – control panel system logic provides constant level control of the wetwell level by use of associated pump VFDs as described below. The primary bubbler system is utilized for level control of the pumping system unless the below scenario occurs. The control panel is to decipher wetwell level readings from both the primary and the secondary bubbler systems. In the event the primary and secondary bubbler system level readings differentiate by 12 inches or more for a period of at least 20 seconds, the control panel is to initiate an alarm process and automatically default to the higher bubbler system level reading for control of the pumping systems (control panel to include bubbler comparison logic). Level differential and time delay settings to be fully adjustable via the control panel door mounted operator interface unit

c) Secondary Bubbler – control panel system logic provides constant level control of wetwell level by use of associated pump VFDs as described below. Control mode remains in secondary bubbler level mode regardless of wetwell level readings.

c. Wetwell Level Control (Constant Level):

1) As level in the wetwell rises above an adjustable Lead Pump “ON” setpoint, system logic shall start the lead pump by use of an associated VFD. The VFD shall ramp up in speed as required to control the wetwell level to the desired level setpoint. The wetwell level setpoint shall be fully adjustable via the control panel door mounted Operator Interface Unit (OIU).

2) Should wetwell level continue to increase while the lead pump is operating, system logic shall ramp the lead pump VFD speed up to maintain the desired level setpoint. Should influent flow (wetwell level) exceed the capacity of the lead pump, system logic shall automatically stage on the first lag pump after the lead pump has been operating at its maximum speed for a programmable time delay. Once running, the first lag pump VFD shall ramp up in speed to match that of the lead pump. System logic shall then control the speed of both pumps simultaneously as required to control the wetwell level to the desired level setpoint. The lead pump maximum speed and time delay setpoints for staging on the first lag pump shall be fully adjustable via the control panel door mounted OIU.

3) Should the wetwell level decrease while both pumps are operating, system logic shall ramp pump VFD speeds down simultaneously as required to control the wetwell level to the desired setpoint. Should the wetwell level decrease to a point that both pumps are operating at their minimum speeds for a programmable time delay system logic shall shutdown the first lag pump. The lead pump speed shall then be controlled as required to control the wetwell level to the desired setpoint. The minimum speed and time delay setpoints for staging off the first lag pump shall be fully adjustable via the control panel door mounted OIU.

4) The lead pump shall continue to operate, controlling the wetwell level to the desired setpoint, should wetwell flow decrease to a point that system logic ramps the lead pump VFD down to its minimum speed (programmed in the VFD) and wetwell level continues to drop below the Lead Pump “OFF” setpoint, system logic shall shut down the lead pump. The lead pump shall remain off until wetwell level once again rises above the Lead Pump “ON” setpoint initiating the next pump down cycle.

5) Should influent flow exceed the capacity of the lead and first lag pump, system logic shall automatically stage on the second lag pump after the initial two pumps have been operating at maximum speed for a programmable time delay. Once running, the second lag pump VFD shall ramp up in speed to match that of the initial two pumps. System logic shall then control the speed of all three pumps simultaneously as required to control wetwell level to the desired level setpoint. The lead/lag pumps maximum speed and time delay setpoints for staging on the second lag pump shall be fully adjustable via the control panel door mounted OIU.

6) Should the wetwell flow decrease while all three pumps are operating, system logic shall ramp all pump VFD speeds down simultaneously as required to control the wetwell level to the desired setpoint. Should the flow decrease to a point where all three pumps are operating at their minimum speeds for a programmable time delay system logic shall shut down the second lag pump. The initial two pump speeds shall then be controlled as required to control the wetwell level to the desired setpoint as described above. The minimum speed and time delay setpoints for staging off the second lag pump shall be fully adjustable via the control panel door mounted OIU.

7) Like that described above, if influent flow exceeds the capacity of the initial three pumps, system logic shall automatically stage on the third lag pump as wetwell level continues to rise. System logic shall then shut down the pumps in similar fashion described above as wetwell level falls and pumps have been operating at their minimum speeds for a programable time. Note, four (4) pumps maximum can be called to run at the same time. Minimum speeds, maximum speeds, time delays, etc. are to all be user adjustable at the station control panel door mounted OIU.

8) Operator adjustable high and low level alarm setpoints shall be provided for alarm annunciation of an abnormally high or low wetwell level condition. Alarm setpoints and associated time delays for high and low level alarms shall be fully adjustable via the control panel door mounted OIU. All level alarms shall be announced on the control panel door mounted OIU, common alarm light and alarm horn.

9) Operator adjustable pump maximum and minimum speed setpoints shall be fully adjustable via the control panel door mounted OIU.

d. Pump Alternation and Sequence Selection:

1) Pump alternation and sequence selection shall be provided for the main pumps thru the door mounted OIU on the control panel.

a) Manual Selection – A manual sequence table will be provided on the door mounted OIU. Operators can choose which pump becomes the lead pump and the following lag pump sequence.

b) Auto Selection – Lead Pump determined by system logic, alternation between pumps on each pump down cycle, lead pump runtime (adjustable via OIU), or upon lead pump not being available for operation.

e. Pump Motor Winding Temperature Monitoring & Seal Leak Monitoring:

1) Each pump is equipped with seal leak detection and high motor winding temperature switches. The control panel shall monitor these elements via discrete PLC inputs.

2) In the event of a motor winding temperature alarm, system logic shall shut down the respective pump and render it unavailable for operation.

3) In similar fashion in the event of a seal leak detection/condition, system logic shall shutdown the respective pump and render it unavailable for operation.

4) All seal leak and motor high temperature alarms shall be announced on the respective control panel door mounted OIU, common alarm light and alarm horn.

f. Pump Availability:

1) A pump shall be considered unavailable for operation when any of the following conditions occur:

a) Respective pump mode of operation selector switch is in the “OFF” position

b) Respective pump fails to start

c) Respective pump VFD failure

d) Wetwell low-level condition

e) Pump high-vibration condition (top of pump bearing frame)

f) Motor high-vibration condition

g) Motor winding high-temperature condition

h) Pump high-temperature condition (pump thrust bearing)

i) Pump high-temperature condition (pump intermediate shaft bearing)

j) Pump seal-leak condition

g. Additional System Monitoring:

1) In addition to monitoring and controlling the pumps based upon wetwell level it is anticipated that the control panel will monitor the following systems:

a) Ventilation systems

b) Emergency generator systems

c) Door contacts (intrusion)

d) Gas monitoring systems

e) Various instruments (pressure, flow, etc.)

f) Refer to Contract Drawings and I/O Table for additional information and I/O that is to be incorporated within each control panel.

h. Alarm Monitoring:

1) All system alarms shall be announced locally via the panel mounted OIU, common alarm pilot light, and alarm horn. Alarm acknowledgement, reset, and horn silence of alarms shall be provided by a control panel door mounted pushbutton.

i. SCADA Connectivity:

1) Each station control panel is to be integrated within the County existing SCADA network. Communication equipment to facilitate the integration to be provided within each station control panel. Refer to SCADA integration article below for additional information.

PART 2 PRODUCTS

2.01. PUMP CONTROL PANELS – TYPICAL OF 2 (PLC-UH & PLC-TA)

A. The control panel shall be housed in NEMA 12 floor mount enclosure constructed of 12-gauge steel with white polyester powder paint inside, ANSI 61 gray polyester powder paint outside over phosphatized surfaces. The enclosure shall be 72" high by 60" wide by 20" deep. The dimensions provided are maximum. The contractor may utilize smaller enclosure if approved by the engineer to house the hardware specified and meet the intent of the specification herein.

1. Provide enclosure with 12" floor stand kit. Contractor to anchor to floor in location as indicated on contract drawings

2. Provide enclosure as a double door with 3-point latch system.

3. Provide doors with a gasket system.

4. Control panel to be provided with a fan/filter and thermostat kit per manufacturer’s recommendations.

5. Control panel to be provided with internal climate control heater (refer to below).

6. The enclosure to be Hoffman A726020ULPG or approved equal.

B. Control panels shall be equipped with a climate control heater designed to protect sensitive electronic equipment from the harmful effects of condensation, corrosion, and low temperatures. The heater shall have the following features as a minimum (to be confirmed with manufacturer during submittal phase):

1. Operating voltage - 115VAC

2. Wattage - 200W

3. Durable anodized aluminum housing

4. Integral thermostat adjustable from 0°F to 100°F (-18°C to 38°C)

5. Continuously running ball bearing fan for even temperature distribution

C. During submittal phase manufacturer to provide control panel heating calculations. Intent is to detail if cooling (Air Conditioning) is required for the control panel. Contractor to provide air conditioning unit for the control panel if recommended by manufacturer/CSI because of the calculations. Calculation to consider the following:

1. Calculate total heat generated.

2. Calculate temperature rise

3. Calculate heat dissipation

4. Compare/contrast calculation versus component ratings.

5. Account for space HVAC design

D. Control panel shall be UL 508A listed or UL 698A listed, whichever is applicable. The UL “sticker” shall be clearly displayed in the appropriate location within the panel. Third party substitutions of UL 508A/698A listed equipment shall be strictly prohibited.

E. Panel Input power shall be 120VAC, 1 Phase, 60Hz. Provide a sufficiently sized main circuit breaker disconnecting means. Interlock main circuit breaker disconnect with the control panel door handle.

F. Refer to Electrical Drawings for additional information/requirements.

G. A 120VAC single phase surge protector shall be provided for the incoming 120VAC supply. The surge protector shall be designed to protect electrical and electronic equipment against transients caused by lightning, induction, load switching, EMP and other sources. Line to neutral, line to ground and neutral to ground protection shall be provided. The surge protector shall have a protection level of 1kV and a maximum discharge current of 140 kA as a minimum. The surge protector shall have a remote signaling device for fault indication to the PLC. The AC surge protector shall be CITEL model DS72RS-120 or approved equal.

H. All communication cabling that exits the building shall have surge protection provided.

I. An analog signal surge protector shall be provided for protecting analog input signals from electrical surges caused by lightning and other sources. The surge protector shall have the following features as a minimum:

1. Designed specifically for 4-20 mAdc and pulse signal lines including both two and four wire transmitters

2. Shall be capable of absorbing electrical surges with no interruption to instrumentation signal

3. Shall have a removable arrester element that when unplugged from the base will not interrupt the instrumentation signal

4. Surge protector housing shall be constructed of flame-resistant resin

5. Maximum Line Voltage of 30VDC

6. Discharge Voltage – Line to line of 30V minimum and line to ground of 500V minimum

7. Maximum Surge Voltage – Line to line of 40V maximum and line to ground of 650V maximum

8. Response Time – Line to line of less than 4 nanoseconds and line to ground of less than 20 nanoseconds.

9. Discharge Current Capacity of 5000A

10. Internal series Resistance of approximately 20 ohm including return

J. Short circuit protection of 120VAC input and UPS control power shall be provided by a miniature branch rated circuit breaker with an interruptive capacity of 10K amperes at 240VAC. Circuit Breakers shall be Allen-Bradley 1489 series or approved equal.

K. One print pocket shall be provided on the control panel door. One complete set of electrical control drawings shall be provided in the pocket.

L. Separate circuit breaker disconnects for each load supplied from the control panel shall be provided. All branch circuits shall be short circuit protected.

M. The control panel shall be provided with an Uninterruptible Power Supply (UPS) for protection against power disturbances, noise, and brownouts. Refer to article below for UPS specifications.

N. The control panels shall be provided with a fully redundant Programmable Logic Controller (PLC) system. The PLCs shall be factory programmed, tested, and debugged to meet all the requirements of the applicable process. PLC system to be ControlLogix platform as manufactured by Allen Bradley or approved equal. Refer to article below for additional PLC specifications/requirements.

1. Control panels to be provided with fully redundant control systems. Control panels to be provided with two (2) PLCs that operate in tandem/parallel. In the event one PLC system fails the control shall not miss a beat and automatically switch to the redundant PLC system (hot standby configuration). Control panels to be provided with all required CPUs and associated redundancy modules, including but not limited

to the following: redundant Ethernet modules, redundant I/O modules, redundant power supplies, redundant PLCs, and completely redundant rack.

2. Provide redundant Ethernet connection between OIU and PLC.

O. The control panel shall be provided with a door mounted 15" Operator Interface Unit (OIU) for system monitoring, setpoint entry/review and alarm annunciation. Communications between the OIU and PLC shall be Ethernet. The OIU shall be color touchscreen. Refer to article below for OIU specifications.

1. Provide redundant Ethernet connection between OIU and PLC.

P. The control panel shall be provided with a fully managed industrial Ethernet switch/media converter for network communications and programming. Additional Ethernet ports shall be available for system programming, connectivity to future Local Area Network (LAN), and connection to future Ethernet devices. Refer to article below for fully managed Ethernet switch specifications.

Q. Control panel shall be provided with a DC power supply: a 24V direct current power supply shall be provided to power the PLC, OIU, I/O, and all ancillary equipment. The power supply shall have an operational input range of 85 to 132VAC and shall have a minimum rated output of 24 to 28VDC/240 watts. The power supply shall be PULS QS10.241 or approved equal.

R. The control panel shall provide visual alarm annunciation via common alarm pilot light and OIU alarm screen. Pilot light shall be 30mm, industrial grade, push-to-test type, Allen-Bradley 800T series or approved equal.

S. The control panel shall provide audible alarm annunciation via alarm horn. Alarm horn shall provide a typical sound pressure of 95 + 5 dB(A) at 30VDC, at 24 inches and shall have a built-in volume control providing variable attenuation up to 20 dB(A). The alarm horn shall be Floyd Bell model MC-V09-530-Q or approved equal.

T. A momentary pushbutton shall be provided for alarm acknowledgment/reset and alarm horn silence, pushbutton shall be 30mm industrial grade, Allen-Bradley 800T series or approved equal.

U. Control panel shall have a single tube, LED light fixture, 10 Watt in size, mounted internally to the ceiling of the panel. Light fixture shall be switched and shall be complete with the lamp.

V. Control panel shall have one (1) specification grade duplex convenience receptacle with ground fault interrupter, mounted internally within a stamped steel device box with appropriate cover. Convenience receptacles shall not be powered from a UPS and shall be protected by a dedicated fuse or circuit breaker.

W. AC power fuses shall be provided as required for over current protection of individual AC powered panel components. Single circuit fusible terminal blocks with neon blown fuse indicators suitable for use with ¼” x 1 ¼” glass fuses shall be provided for each circuit requiring fuse protection. Fusible terminal strips shall have a working voltage rating of 100 to 300VAC, and have a current rating of 12 Amps, fuse blocks shall be Allen-Bradley model 1492-H4 or approved equal.

X. DC power fuses shall be provided as required for overcurrent protection of individual DC powered panel components. Single circuit fusible terminal blocks with LED blown fuse indicators suitable for use with ¼” x 1 ¼” glass fuses shall be provided for each circuit

requiring fuse protection. Fusible terminal strips shall have a working voltage rating of 10 to 57V AC/DC, and have a current rating of 12 Amps, fuse blocks shall be Allen-Bradley model 1492-H5 or approved equal.

Y. Interposing and control relays shall be provided as required. They shall be of industrial grade, plug-in socket type, and shall have 24VDC or 120VAC coils and 2PDT or 4PDT form C relays as required. All relay contacts shall be silver nickel plated, 2PDT relay contacts shall be rated for 10A at 300VAC and 4PDT relay contacts shall be rated for 7A at 300VAC. All relays shall be provided with a standard ON/OFF flag indicator, mounting base and retainer clip. Control relays shall be Allen-Bradley series 700-HC or approved equal.

Z. Compression type terminal blocks shall be provided for all field connections, wiring field equipment directly to PLC I/O bases or other panel components is not acceptable. Terminal blocks shall have the following electrical ratings as a minimum:

1. Two Level Terminal Blocks

    a. Rated Voltage: 300V AC/DC
    b. Rated Current: 20 Amp
    c. Wire Size Range: 30-12 AWG

2. Three Level Terminal Blocks

    a. Rated Voltage: 300V AC/DC
    b. Rated Current: 10 Amp
    c. Wire Size Range: 26-14 AWG

3. Terminal blocks shall be Allen-Bradley series 1492 or approved equal.

AA. The control panels to be provided with door mounted Elapsed Time Meters (ETMs) for accumulating the pump operational runtimes. The ETMs shall be 24VDC powered and have a six digit counter indicating accumulated runtime to 1/10th of an hour. Typical of four (4) pumps per station.

AB. The control panels are to interface with the operator control station for each of the pumps. Operator control station (hand-off-auto switch) located on the respective pump motor starter (VFD). Refer to below I/O list and electrical drawings for additional information.

AC. The control panels are to be provided with pre-configured space for the installation of an internet modem. This device is to be furnished by others (owner service provider) and installed within each station control panel as part of this contract. Equipment intended to provide internet access and allow network communications with the existing County SCADA system.

1. Contractor to collaborate with the owner’s service provider (Optimum) to prepare space within each control panel for installation of internet modem.

2. Contractor to provide internet cabling to station control panel as specified on the contract drawings.

AD. The control panels are to be provided with a router to allow secure network communications with the existing County SCADA system.

1. Contractor to provide Cisco 1811 integrated services router or approved equal within each station control panel. Contractor to configure router to allow for secure network communications with existing SCADA system.

AE. The control panels shall be provided with intrinsically safe barrier(s) for the wetwell float switch inputs. All Intrinsically safe wiring shall be separated from other wiring by a distance of at least 2 inches, secured from conductors and cables of non-intrinsically safe circuits. Physical barriers shall be installed where required to prevent intrinsically safe circuits from encountering non-intrinsically safe circuitry.

AF. System to include Modbus mapping capability. Coordinate final requirements with the owner.

AG. The control panels shall be provided with an integrally mounted and wired telephone alarm dialer for remote annunciation of system alarms. Refer to article below for additional dialer specifications/requirements.

AH. The control panels shall be completely factory assembled, wired, configured, and tested prior to being shipped to the project site.

1. The Engineer shall have the right to witness the factory tests and inspect any equipment to be furnished under this Section prior to their shipment from the place of manufacture.

2. The Contractor shall make all arrangements and pay for all travel and expenses for up to three people from the Owner and Owner’s Engineer to witness the shop tests.

2.02. WETWELL FLOAT SWITCHES

A. Float switch shall be of the direct acting type, containing a single pole non-mercury switch, which actuates when the longitudinal axis of the float is horizontal, and deactivates when the liquid level falls 1" below the actuation elevation.

B. Each float shall be housed in a chemical resistant polypropylene casing with a firmly bonded electrical cable protruding. One end of the cable shall be permanently connected to the enclosed switch with the entire assembly encapsulated to form a completely watertight and impact resistant unit, provide enough cable length as required to reach the control panel as indicated on the Contract Drawings.

C. Float switches shall be suitable for low-current operation compatible with intrinsically safe barriers and/or PLC inputs.

D. A coated steel anchor assembly with stainless steel chain and float clamps shall be provided for installing the float switch as indicated in the Contract Drawings. Float switches to be installed along the wall (as indicated on Contract Drawings) with sufficient cable length to reach associated control panels. Contractor to field verify.

E. Float switches shall be Flygt model ENM-10 or equal. Typical of two (2) float switches required per station for a total of four (4). Refer to the Contract Drawings for additional information.

2.03. BUBBLER SYSTEM – TYPICAL OF TWO SYSTEMS

A. Contractor to provide a complete air bubbler system (UL Listed) for monitoring levels within each wetwell chamber. Bubbler system to be provided for each of the two (2) stations. The air bubbler and all associated appurtenances shall be installed within a dedicated

enclosure as indicated on the Contract Drawings. A single bubbler system with tubing to each of the wetwells is required.

B. Wetwell level shall be measured by a pressure-to-current (P/I) transmitter located in the air bubbler panel. Major system components shall consist of the P/I transmitter, low pressure air supply, and two (2) air-lines extending into and terminating near the bottom of each wetwell. An air selector valve shall be provided to allow either of the two wetwell levels to be monitored as well as monitoring wetwell levels at the same time. The air supply shall continuously purge the airline. P/I transmitter output shall be 4-20mA DC proportional to wetwell level and shall be connected to the control panel PLC through an analog input. Each control panel shall utilize this signal for control, monitoring, trending, and alarm.

1. Refer to Contract Drawings for dimensions/depth of wetwell. Contractor responsible for providing a system which monitors the level over the entire range (empty - full). Typical of each wetwell chamber.

C. Ancillary air bubbler system components shall include, but not be limited to, the following:

1. Two (2) AC air compressors shall deliver free air from 1 to 4 scfm.

    a. Air compressors shall be rated for use on a 120-volt, single-phase, 60 hertz power supply.

    b. Provide automatic and timed cycle air tube purging

    c. Provide automatic air tank moisture drain valve control

    d. Air compressor and system status indicators to be displayed on front panel

2. Control Module

3. High accuracy pressure transducer (Air Tank & Bubbler Tube)

4. Pressure gauge

5. Level digital display

6. Air flow indicators, Dwyer model RMA-5-SSV or approved equal

7. Air compressor selector switch

8. Wetwell airline selector switch, Parker XM40NBG553A.

9. Purge valve, isolation valve, check valve, and relief valve as required.

10. Calibration potentiometers

11. Air piping from bubbler system to each wetwell chamber

    a. Utilize 3/8" stainless steel tubing and 1/2" schedule 80 PVC as indicated below.

12. 3” PVC air bell for installation within each wetwell

    a. Air bell to be shipped loose for Contractor installation within the field.

D. Contractor to provide 3/8” air piping (stainless steel tube) from bubbler system control panel and transition to 1/2" schedule 80 PVC rigid pipe outside the control panel. Provide fittings to transition from 3/8" air piping to 1/2" PVC pipe. The 1/2" schedule 80 PVC pipe is to then be routed to each wetwell chamber. All tubing/piping to be sloped towards the wetwell to allow condensate drainage and tees shall be provided at all changes in direction. All wet well brackets, hardware and supports shall be 316 stainless steel. The contractor shall confirm air piping diameter with air bubbler system requirements. Refer to the contract drawings for additional information.

1. Contractor to coordinate final routing of air tubing/piping in the field with the owner/engineer prior to rough-in.

E. Contractor to provide air bell within each wetwell chamber. Air bell to be comprised of 3-foot section of 3” schedule 80 PVC pipe. Provide necessary fittings to reduce/connect 1/2" PVC air pipe to the 3" air bell. Contractor to support/attach air bell to wetwell as well as support the 1/2" air piping. Utilize stainless steel pipe standoff supports within the wetwell for support/anchor every 24 inches. Refer to contract drawings for additional information.

1. Air bell to not be supported by 1/2" air pipe. Must be independently supported to wetwell.

2. Refer to Contract Drawings for dimensions/depth of wetwell. Contractor responsible for providing a system which monitors the level over the entire range (empty - full). Provide suitably sized air bell. Typical of all station wetwells.

F. Contractor to provide all necessary tubing, piping, valves, fittings, connectors, elbows, etc. to place in operation a complete and operable bubbler system for wetwell level monitoring (typical of both Union and Tallman Pump Stations).

G. Bubbler systems to be model number 12138-2 as manufactured by Digital Control Company or approved equal.

2.04. UNINTERRUPTIBLE POWER SUPPLIES (UPS)

A. Capacity: 1000 VA / 600 W

1. Contractor to confirm UPS sizing based upon devices shown on Contract Drawings requiring UPS power. Adjust UPS output size/configuration as required to provide UPS power to devices shown on the Contract Drawings.

2. Each control panel to be provided with a UPS.

B. Topology: Line Interactive

C. Waveform: Sine Wave

D. Output: 120 VAC ± 5%

E. Plug type & cord: NEMA 5-15P, 5 ft. cord

F. Outlet types: 10 × NEMA 5-15R

G. Communication: USB, Serial

H. Data line protection: Telephone, Ethernet, Coaxial

I. Management software: PowerPanel® Personal

J. ENERGY STAR® qualified: Yes

K. Certifications: UL1778

L. Warranty: 3 year

M. Uninterruptible Power Supplies shall be CyberPower model CP1000PFCLCD or approved equal.

2.05. PROGRAMMABLE LOGIC CONTROLLERS (PLC)

A. The pump control panels shall be provided with a fully redundant Programmable Logic Controller (PLC) system. The PLCs shall be factory programmed, tested, and debugged to meet all the requirements of the applicable process. PLC system to be ControlLogix 5580 platform as manufactured by Allen Bradley or approved equal.

1. Control panel to be provided with a fully redundant control system. Control panel to be provided with two (2) PLCs that operate in tandem/parallel. In the event one PLC system fails the control panel shall not miss a beat and automatically switch to the redundant PLC system (hot standby configuration). Control panel to be provided with all required CPUs and associated redundancy modules, including but not limited to the following: redundant Ethernet modules, redundant I/O modules, redundant power supplies, redundant PLCs, and completely redundant rack.

B. PLC system to have the following built-in communication ports:

1. EtherNet/IP

2. USB

C. PLC system to have the following communications options:

1. EtherNet/IP – 1 gigabit (Gb)

2. USB for firmware download and programming (local programming)

D. PLC system to have an onboard display included.

E. PLC system to have an energy storage module included.

F. PLC system to be provided with associated programming software support. Provide as studio 5000 logix designer or as recommended by equipment manufacturer.

G. PLC system to have the capacity of storing up to 5MB of user memory.

I. PLC system to have the capacity to support up to 128,000 digital and 4,000 analog I/O points thru use of I/O expansion Modules.

1. Provide all I/O modules (discrete & analog) and cards to meet site specific I/O requirements, plus 20% spare I/O points of each type used. Coordinate requirements with the owner, Contract Drawings, and I/O table.

L. PLC system to be provided with controller, communication, chassis, and power supply as recommended by equipment manufacturer.

N. PLC system shall be capable of stand-alone operation in the event of failure of the communication link to the OIU subsystem.

P. The Programmable Logic Controllers (PLCs) shall be Allen-Bradley ControlLogix 5580 series (model 1756-L82E) or approved equal. Provide duplicate systems for full redundancy as specified.

2.06 OPERATOR INTERFACE UNIT (OIU)

A. Display:

1. Display Type: Color active-matrix TFT

2. Size: 15-inch, 13.39”W x 9.65”H display area

3. Resolution: 1024 x 768, 18-bit color graphics

4. Touch Screen: analog resistive

B. Operating System:

1. Microsoft Windows CE with extended features and MS Office Viewers

C. System Memory:

1. 512 MB RAM, 512 MB nonvolatile storage for applications.

D. External Storage:

1. Secure Digital (SD) card, cat. no.1784-SDx

2. USB flash drives supported by high-speed, hot-swappable, 2.0 USB host ports

E. Battery (Real-Time Clock)

1. Battery-backed time clock timestamps critical data. Accuracy +/-2 minutes per month

F. 6. Environmental Operating Temperature:

1. 0 - 55°C (32 - 131°F)

G. Ratings

1. NEMA 12, 13, 4X, IP66 as classified by UL

D. USB Ports:

1. Two USB high-speed 2.0 host ports (type A) support removable flash drives for external storage

E. Ethernet Ports:

1. Two 10/100Base-T, Auto MDI/MDI-X Ethernet Ports that support Device Level Ring (DLR), linear or star network topologies

F. Input Power

1. 18-32V DC (24VDC nominal)

G. Standard Software:

1. Software FactoryTalk View Machine Edition software, version 7.0 or later

2. FactoryTalk ViewPoint software, version 2.6 or later

3. PDF viewer

4. Active X Controls

5. Remote Terminal Control

6. FTP Server

H. Additional Software:

1. Provide RSView Studio Development for Machine Edition part number 9701-VWSTMENE or approved equal.

I. The Operator Interface Unit (OIU) shall be Allen-Bradley PanelView Plus 7 model 2711P-T15C22D9P, 15” or approved equal.

2.07 FULLY MANAGED ETHERNET SWITCH/MEDIA CONVERTER

A. Sixteen (16) port managed industrial Ethernet switch

1. Fourteen (14) 10/100BaseTX RJ-45 Ports

2. Two (2) 100BaseFX Multimode Fiber Ports with SC Connectors

B. -40°C to 70°C Operating Temperature

C. ESD and Surge Protection on all Built-in Ports

D. Auto Sensing 10/100BaseTX, Duplex, and MDIX

E. Store-and-forward Technology

F. Redundant Power Inputs (10-30 VDC)

G. 8000 MAC Addresses

H. Configurable Alarm Contact

I. Configurable Bi-Color Fault Status LED

J. Rugged Industrial DIN-Rail Enclosure

K. Fully Managed Features:

1. SNMP v1, v2, v3 and Web Browser Management

2. N-Ring™ Technology with ~30ms Healing

3. N-Link™ Redundant Ring Technology

4. N-View™ Monitoring Technology

5. EtherNet/IP™ CIP Messaging

6. Web configuration

7. IGMP Auto Configuration

8. 802.1Q tag VLAN and Port VLAN

9. 802.1p QoS and Port QoS

10. Port Trunking

11. Port Mirroring

12. 802.1d, 802.1w, 802.1D RSTP

13. DHCP Server with Option 82 Relay, Option 61, and IP Fallback

14. Local Port IP Addressing

15. 802.1AB-2005 LLDP (Link Layer Discovery Protocol)

16. Port Security - MAC Address Based Filtering

L. The fully managed Ethernet switch/media converter shall be N-TRON model 716FX2-SC or approved equal.

2.08. MAGNETIC FLOW METER

A. The Contractor shall furnish and install, ready to operate, the magnetic-type flow metering equipment, complete with flow tube, remote mounted flow transmitter, interconnecting cables and all necessary accessories, in compliance with the following specifications and as shown on the Contract Drawings.

B. Contractor to provide a total of two (2) magnetic flow meters and associated remote transmitters. Unit to be utilized with an associated ductile iron pipe size specified on the contract drawings (refer to below pipe sizes) and be suitable to measure applicable flow range at each station. Coordinate with the engineer during submittal phase.

1. Two (2) flow meters. One on the main 24” discharge piping at Tallman Pump Station and the other on the main 24” discharge piping at Union Pump Station. Both suitable to measure flow range of 6,945 gallons per minute or 10,000,000 gallons per day.

C. Contractor is responsible to verify with the supplier that the appropriate ratings and options are provided for each application, taking into account area classification, flow, passing media, temperature, and vacuum limitations. Any such deviation from that which is specified shall be brought to the Engineers' attention during shop drawing submittals.

D. Contractor to coordinate necessary factory/interconnect cable length between flow tube/element and remote flow transmitter.

E. Produce a pulsed DC magnetic field that, when applied to a conductive liquid, generates an induced voltage as the liquid flows through the magnetic field. Generate voltage directly proportional to the flow of the metered liquid. Identify the ratio of flow velocity to voltage generated for all meter sizes, thereby permitting primary head and transmitter direct adaption and interchangeability without circuit modifications or system recalibration.

F. Flow Element Design:

1. Flow elements shall be magnetic flow tubes, low frequency electromagnetic induction type and shall produce a 4-20 mA output linear to liquid flow rate.

2. The flow tubes shall have ANSI Class 150 flanged ends. Wafer-style flow tubes are not acceptable.

3. The flow tube material shall be 304 stainless steel.

4. Electrodes shall be conical-shaped (bullet nose) and shall be Type 316L stainless steel, Hastelloy C, or Zirconium. Substantiate compatibility with media monitored in the shop drawing submittal.

5. The flow tube housing shall be splash-proof and weather-resistant. It shall be capable of accidental submergence in up to 30 feet of water for up to 48 hours without damage to the electronics or interruption of the flow measurement.

   a. Flow tube shall be provided with potted junction box and combo/cable gland for use in conduit as indicated on drawings. Contractor to assume 100 linear feet of cable for bidding purposes. Final cable length to be coordinated in the field.

6. Empty Pipe Detection - Flow tube shall measure the conductivity between the electrodes to monitor for an empty pipe condition. Upon detection of an empty pipe condition, the flow transmitter shall indicate the pipe is empty on the main transmitter display and drive the flow signal to zero.

7. Grounding Rings:

   a. Provide two grounding rings installed on each end of the flow tube. Ground rings to be 316L stainless steel. Contractor to bond ground rings together to grounding lug on housing of flow tube using #4 bare copper conductor.

G. Flow Transmitter Design:

1. Signal converters shall be wall mounted, housed in a NEMA 4X enclosure.

2. Terminal strips for electrical connections shall be supplied. Housing shall not need to be opened to make adjustments.

3. Transmitter (Converter) Electronic Characteristics

   a. The electronics shall be of the solid-state, feedback type and utilize integrated circuitry.

b. The input span of the signal converter shall be continuously adjustable between 0 to 1 and 0 to 31 fps and the range adjustment shall be direct reading. Final requirements to be coordinated with the engineer during the submittal phase.

c. Complete zero stability shall be an inherent characteristic of the meter system to eliminate the need to zero adjust the system with a full pipe at zero flow.

d. The converter shall not be affected by quadrature noise nor shall it require zero adjustment or special tools for startup.

e. Input and output signals shall be fully isolated.

f. Outputs:

1) 4-20 mA into 500 ohms, providing 50 megohms of isolation from ground, and isolated from the transmitters power supply. Minimum of 250 ohms is required for HART communicator.

2) Pulse output with minimum time duration of 0.5 seconds.

g. The electronics shall be designed for operation on 120 VAC +10 percent, 60 Hz +5 percent.

h. The converter shall also include:

1) Integral zero return based upon a user-adjustable percentage of flow meter span. Setpoint shall be adjustable 0 to 10 percent.

2) Direct adjustment of scaling factor in Engineering units.

3) Integral calibration self-test feature to verify proper operation at the electronics.

4) Local direct reading indicator calibrated in gallons per minute or million gallons per day as directed by the Engineer. Flow totalizer with manual reset.

i. Each meter shall be hydraulically calibrated to the specified flow range in a NIST-certified facility.

H. Performance Requirements:

1. The equipment furnished shall measure, indicate, and transmit flow rates to within +0.5 percent of actual flow from a flow velocity of 1.0 to 31 fps (feet per second). Final requirements to be coordinated with the engineer during submittal phase.

2. Accuracy shall not be affected by changes in percent solids or changes in fluid density, temperature, or viscosity. Accuracy shall not be affected by the presence of air bubbles to a greater extent than the fluid volume represented by such air bubbles.

3. Maximum power consumption for each flow element shall be 15 watts.

4. Equipment design specifications shall be considered as an integral part of the performance requirements.

I. Accessories:

1. Nameplates – Provide nameplate, wording of nameplate shall be as identified on the contract drawings (device tag).

2. Mounting Hardware - Provide stainless steel mounting hardware as necessary to mount equipment in locations as described in the Contract Documents.

3. Cabling - Provide power and signal circuitry as specified and as shown on the Contract Documents.

4. Flow tubes shall be provided with grounding rings on each flange. Grounding electrodes or straps are not an acceptable alternative. Materials of construction shall be Type 316L stainless steel, Hastelloy C, or Zirconium as chemically compatible with the measured media.

5. Portable secondary calibrator for checking calibration of the magnetic flow meters shall be provided. The unit shall have an adjustable setting to simulate signal output for a given flow velocity from 0 to 99.99 ft/sec. This unit is not required for flow meters with calibration checking integral to the transmitters.

J. The flow metering equipment manufacturer and model shall be the following or equal:

1. Emerson/Rosemount 8750W with remotely mounted 8712E transmitter for utility, water, and wastewater applications.

2.09 PRESSURE TRANSMITTER

A. Operational

1. Input range: As required

2. Output: 4-20 mAdc, 2-wire, linear and proportional to level

3. Power Supply: 10-36 VDC externally loop powered

B. Performance

1. Accuracy: 0.25% of full scale, including the effects of linearity, hysteresis, and repeatability.

2. Process temperature range: -22 to 248°F

3. Ambient temperature range: -13 to 185°F

4. Maximum working pressure: Two times full range

C. Construction

1. Housing: NEMA 4X Stainless Steel

D. Accessories:

1. Transducer to be provided with factory installed carbon steel/PVC isolation diaphragm with low temperature silicone fill, for lightning and surge protection.

E. Pressure transducer to be Rosemount 3051 Pressure Transmitter or approved equal. Typical of two (2) pressure transmitters required, one for each pump station main header.

2.10. AUTO-DIALER

A. Provide telephone alarm dialers for remote annunciation of system alarms. The dialer enclosure shall be NEMA 1, with integral LED display and keypad. Auto-dialer to have the following features at minimum:

1. Integral LED display and keypad.

2. The dialer shall include an integral battery and associated charger to provide 20-hour operation during power outages. All the dialer's inputs including power supply, telephone line and alarm inputs shall be individually surge protected. The dialer shall be capable of synthesizing the operator's own voice messages and will be capable of monitoring thirty-two (32) discrete inputs plus 120VAC power source. The dialer shall be capable of calling up to thirty-two (32) phone numbers, independently programmable to any or all the alarms.

3. Programmable functions such as independent time delay before calling out, time between consecutive calls and alarm input sense that is normally open or normally closed, shall be inherent.

4. All voice messages and functions will be programmable locally via the dialer's integral keypad or remotely via telephone communications. Security codes (up to 8 digits) shall be programmable to prevent unauthorized access to the dialer's configuration.

5. The alarm dialer shall be modular in design, allowing future expansion of discrete input channels, analog input channels, and remote supervisory control outputs.

6. The alarm dialer shall have a five (5) year parts and labor warranty.

7. Provide an expansion card as required to monitor 32 inputs.

8. Coordinate with the owner for which alarms/signals are to be incorporated in the proposed auto-dialer. Contractor to program the dialer as required. For bidding purposes assume the following list of alarms are to be integrated/hardwired into the auto-dialer:

a. Pump 1 failure (relayed thru VFD)

b. Pump 2 failure (relayed thru VFD)

c. Pump 3 failure (relayed thru VFD)

d. Pump 4 failure (relayed thru VFD)

e. Wetwell high-high condition (from backup float)

f. Station intrusion detected (from station control panel – discrete output)

g. PLC failure (from station control panel – discrete output)

h. Bubbler system failure (from station control panel – discrete output)

i. Ventilation system failure (from station control panel – discrete output)

j. Wetwell high level condition (from station control panel – discrete output)

k. Drywell flood alarm (from station control panel – discrete output)

l. Utility power failure (from station control panel – discrete output)

m. Wetwell low level condition (from station control panel – discrete output)

n. Generator running (from station control panel – discrete output)

o. Gas detection low/high concentration (from station cp – discrete output)

p. Gas detection system failure (from station control panel – discrete output)

9. The alarm dialer shall be RACO model 304VSS-32C or approved equal.

a. Provide with 345VDCA-1 Verbatim Daughter Card Assembly Option

b. Provide with 460VSCADA Verbatim SCADA Card Option

c. Provide with 360V4A-1E/4-20MA analog signal input option.

B. Contractor to provide phone line to station control panel for connection to auto-dialers as specified on Contract Drawings.

C. Provide two (2) days of manufacturer representative startup and training services (one day per station). Intent is to test, troubleshoot, and aid in the installation of the auto-dialer systems.

D. Provide a total of two (2) auto-dialers, one at each station and located within the common station control panel.

2.11. SCADA INTEGRATION

A. Contractor responsible for terminating and testing incoming copper cabling (as specified on Contract Drawings) at each station control panel. Provide all necessary connectors, terminations, etc..

B. Contractor to work with owner’s service provider (Optimum) to integrate internet modem within each station control panel (modem furnished by internet provider). Modem to be utilized to link each pump station with the existing SCADA network.

C. Contractor to provide programming services, integration services, and screen development services as necessary to modify the existing SCADA headend equipment located at the WWTP.

1. Coordinate final SCADA integration services closely with the owner.

D. The existing main SCADA equipment is located at the main WWTP office and is to be modified as necessary to accept the modifications at each of the two (2) pump stations. Provide all programming, integration, and screen development services. Contractor to assume five (5) 8-hour days of on-site services at the existing WWTP main office (head-end SCADA equipment) for bidding purposes.

2.11. SPARE PARTS

A. The following spare parts shall be provided:

1. PLC CPU of each type
2. PLC power supply of each type
3. PLC I/O module of each type
4. 24VDC panel power supply of each type
5. Two (2) surge protectors of each type
6. Five (5) fuses of each type
7. Five (5) pilot light bulbs of each type
8. Five miniature circuit breakers of each type/size
9. Two (2) backup floats
10. Refer to quality assurance article above and PLC article for additional spare information.

2.12. I/O TABLE

A. The below I/O table is to provide systems integrator with a general idea of I/O quantity. I/O table below lists all signals remote from each control panel. Typical signals internal to control panel components (such as UPS failure, power supply failure, etc.) to be included with overall I/O counts (not listed below for clarity). Refer to contract drawings, specifications, and coordinate with owner/engineer for final I/O counts. In addition, refer to above auto-dialer article for various PLC outputs to the auto-dialer. Refer to quality assurance section above for control panel spare capacity requirements.

(continued)

UNION HILL PUMP CONTROL PANEL

Equipment	Function	Signal	Homerun
UH-VFD-1 Influent Pump 1 VFD	Start Pump	Discrete	PLC-UH
	Pump Running	Discrete	
	Pump/VFD Failure	Discrete	
	In Remote	Discrete	
	Speed Indication	Analog	
	Input Speed	Analog	
	Amp Reading	Analog	
	ATS in Emergency Position	Discrete	
UH-VFD-2 Influent Pump 2 VFD	Start Pump	Discrete	PLC-UH
	Pump Running	Discrete	
	Pump/VFD Failure	Discrete	
	In Remote	Discrete	
	Speed Indication	Analog	
	Input Speed	Analog	
	VFD Amp Reading	Analog	
	ATS in Emergency Position	Discrete	
UH-VFD-3 Influent Pump 3 VFD	Start Pump	Discrete	PLC-UH
	Pump Running	Discrete	
	Pump/VFD Failure	Discrete	
	In Remote	Discrete	
	Speed Indication	Analog	
	Input Speed	Analog	
	VFD Amp Reading	Analog	
	ATS in Emergency Position	Discrete	
UH-VFD-4 Influent Pump 4 VFD	Start Pump	Discrete	PLC-UH
	Pump Running	Discrete	
	Pump/VFD Failure	Discrete	
	In Remote	Discrete	
	Speed Indication	Analog	
	Input Speed	Analog	
	VFD Amp Reading	Analog	
	ATS in Emergency Position	Discrete	
Magnetic Door Switch (Motor Room Entrance)	Intrusion Alarm	Discrete	PLC-UH
Magnetic Door Switch (Motor Room Double Door Entrance)	Intrusion Alarm	Discrete	PLC-UH
UH-LE-1 Bubbler Wet Well No.1	Primary Level Control	Analog	PLC-UH
	Common Failure Indication	Discrete	
UH-LE-2 Bubble Wet Well No.2	Primary Level Control	Analog	PLC-UH
	Common Failure Indication	Discrete	
UH-FS-1 Back-Up Float	High Level Alarm	Discrete	PLC-UH
UH-FS-2 Back-Up Float	High Level Alarm	Discrete	PLC-UH
Motor Room High Temperature	Alarm	Discrete	PLC-UH
Pump Room Low Temperature	Alarm	Discrete	PLC-UH
Ventilation Failure	Common Alarm	Discrete	PLC-UH

Equipment	Function	Signal	Homerun
UH-FIT Magnetic Flow Meter	Flow Control	Analog	PLC-UH
	Common Failure Indication	Discrete	
T-AH-1 Air Handler	Failure Alarm	Discrete	PLC-UH
T-AH-2 Air Handler	Failure Alarm	Discrete	PLC-UH
Magnetic Door Switch (Screenings Room Entrance)	Intrusion Alarm	Discrete	PLC-UH
Pump Room Flood Alarm Float	Alarm	Discrete	PLC-UH
Sump Pump Control Panel	High Level	Discrete	PLC-UH
	Low Level	Discrete	
	Low Low Level	Discrete	
	Common Fail	Discrete	
Gas Detection System	Common Alarm Indication	Discrete	PLC-UH
UH-PIT Pressure Transmitter	Pressure Indication	Analog	PLC-UH
Magnetic Door Switch (Screen Room Entrance)	Intrusion Alarm	Discrete	PLC-UH
Emergency Generator System	Running	Discrete	PLC-UH
	Common Failure	Discrete	
ATS	Phase Loss Alarm	Discrete	PLC-UH
	ATS Normal Switch Position	Discrete	
	ATS Emergency Switch Position	Discrete	
Power Monitor	Various Parameter	CAT 6 Link	PLC-UH
Auto-dialer	Refer to Auto-Dialer Article Above		PLC-UH

(continued)

TALLMAN PUMP CONTROL PANEL

Equipment	Function	Signal	Homerun
T-VFD-1 Influent Pump 1 VFD	Start Pump	Discrete	PLC-TA
	Pump Running	Discrete	
	Pump/VFD Failure	Discrete	
	In Remote	Discrete	
	Speed Indication	Analog	
	Input Speed	Analog	
	VFD Amp Reading	Analog	
	ATS in Emergency Position	Discrete	
T-VFD-2 Influent Pump 2 VFD	Start Pump	Discrete	PLC-TA
	Pump Running	Discrete	
	Pump/VFD Failure	Discrete	
	In Remote	Discrete	
	Speed Indication	Analog	
	Input Speed	Analog	
	VFD Amp Reading	Analog	
	ATS in Emergency Position	Discrete	
T-VFD-3 Influent Pump 3 VFD	Start Pump	Discrete	PLC-TA
	Pump Running	Discrete	
	Pump/VFD Failure	Discrete	
	In Remote	Discrete	
	Speed Indication	Analog	
	Input Speed	Analog	
	VFD Amp Reading	Analog	
	ATS in Emergency Position	Discrete	
T-VFD-4 Influent Pump 4 VFD	Start Pump	Discrete	PLC-TA
	Pump Running	Discrete	
	Pump/VFD Failure	Discrete	
	In Remote	Discrete	
	Speed Indication	Analog	
	Input Speed	Analog	
	VFD Amp Reading	Analog	
	ATS in Emergency Position	Discrete	
Magnetic Door Switch (Motor Room Entrance)	Intrusion Alarm	Discrete	PLC-TA
Magnetic Door Switch (Motor Room Double Door Entrance)	Intrusion Alarm	Discrete	PLC-TA
T-LE-1 Bubbler Wet Well No.1	Primary Level Control	Analog	PLC-TA
	Common Failure Indication	Discrete	
T-LE-2 Bubble Wet Well No.2	Primary Level Control	Analog	PLC-TA
	Common Failure Indication	Discrete	
T-FS-1 Back-Up Float	High Level Alarm	Discrete	PLC-TA
T-FS-2 Back-Up Float	High Level Alarm	Discrete	PLC-TA
Magnetic Door Switch (Wet Well No.1 Hatch)	Intrusion Alarm	Discrete	PLC-TA
Magnetic Door Switch (Wet Well No.2 Hatch)	Intrusion Alarm	Discrete	PLC-TA
Motor Room	Alarm	Discrete	PLC-TA

Equipment	Function	Signal	Homerun
High Temperature			
Pump Room Low Temperature	Alarm	Discrete	PLC-TA
Ventilation Failure	Common Alarm	Discrete	PLC-TA
T-FIT Magnetic Flow Meter	Flow Control	Analog	PLC-TA
	Common Failure Indication	Discrete	
T-PIT Pressure Transmitter	Pressure Indication	Analog	PLC-TA
T-AH-1 Air Handler	Failure Alarm	Discrete	PLC-TA
T-AH-2 Air Handler	Failure Alarm	Discrete	PLC-TA
Pump Room Flood Alarm Float	Alarm	Discrete	PLC-TA
Sump Pump Control Panel	High Level	Discrete	PLC-TA
	Low Level	Discrete	
	Low Low Level	Discrete	
	Common Fail	Discrete	
EPO Communicator	Running	Discrete	PLC-TA
	Failure	Discrete	
Emergency Generator System	Running	Discrete	PLC-TA
	Common Failure	Discrete	
ATS	Phase Loss Alarm	Discrete	PLC-TA
	ATS Normal Switch Position	Discrete	
	ATS Emergency Switch Position	Discrete	
Power Monitor	Various Parameter	CAT 6 Link	PLC-TA
Auto-dialer	Refer to Auto-Dialer Article Above		PLC-TA

PART 3 EXECUTION

3.01. INSTALLATION

A. When a change from normal power to emergency power occurs and vice versa all equipment is to be restarted automatically. Final requirements to be coordinated with the engineer. Provide as required.

B. Install equipment at locations indicated on the drawings.

C. Provide all necessary cables, conduits, and fittings as required to provide a fully operable system. All wiring external to control panels shall be in conduit or sealtite. Refer to the raceway schedule on the contract drawings for additional information/requirements.

D. Refer to the contract drawings for all field wiring specifications/requirements.

E. Coordinate all circuitry (conduit & conductor) requirements closely with the Electrical Contractor (Division 16).

1. The Electrical contractor is to provide/install all circuitry from control panel to control panel and from control panel to equipment/devices per the Electrical Drawings. As part of this contract all wiring is to be terminated within the applicable control panel.

To clarify, the EC will run the wire and this contract is to terminate all wiring within the specified control panel, as necessary.

F. Point test all PLC I/O to verify that all I/O modules are correctly wired to the terminal strips and that the PLC I/O modules function properly. Testing shall be performed between terminal points on the I/O module to the terminal strip that the field device is terminated on.

G. Contractor to perform point-to-point wire testing on all circuitry entering/leaving the control panels. Verify wire integrity, continuity, and proper transmission of signal. Close coordination with Electrical Contract required.

3.02. GRAPHIC DISPLAYS/SCREEN DEVELOPMENT

A. Systems integrator responsible for developing all screens associated with each control panel specified as part of this section and loading onto control panel as required. Coordinate with the owner and engineer.

B. General Requirements:

1. All displays shall contain and continuously update the displayed process variables, date, and time of day. All process values shall be displayed in engineering units. All displays shall incorporate references to both instrumentation tag numbers and plant equipment numbers. All process variables shall be displayed on their associated display(s) with correct engineering units. Process variables shall display their associated data quality flags.

2. All operator commands related to controlling field devices or system attributes shall require multiple keystrokes or mouse actions to protect against inadvertent operations. The operator shall receive confirmation of the selected point to be checked, at which time a cancellation of the control can be affected.

3. Process graphic displays, shall be based on the P&ID's, site plan drawings, mechanical drawings and electrical drawings included as part of these Contract Documents. The graphic displays shall depict process flow streams, process structures, and all major items of process equipment and control devices in a schematic format.

5. All main graphical screens shall include a title bar, main graphic area, navigational buttons, and alarm summary bar. Title bar shall be displayed on the top of each screen and include display name, description, and time/date. The main graphical area shall contain primary screen data in graphical format. Navigational buttons shall include a minimum of main menu, trends, main alarm summary, and security log in. The alarm summary bar shall display the last three valid alarms on the bottom of each screen.

6. Animation shall be provided to mimic level changes in tanks or vessels, and to mimic rotation of rotating equipment when running. Valve colors shall change when opened and closed.

7. Unless specifically noted, all timers, setpoints, alarm actuation levels, etc., shall be adjustable from the operator interface.

8. The system shall show field conditions with text that can alternate (i.e., OPEN/CLOSE, START/STOP, HIGH/LOW) and change color correspondingly. Field devices that are tri state must be represented in three conditions.

9. Conditions in the field designated as alarm conditions shall report to the operator workstation, actuate an audible alarm, and provide a visual blinking image on the associated graphic page. All alarms and events shall be displayed on the screen and archived.

10. All interlocks that affect equipment operation shall be identified both by alarm and by OIU indication.

11. All analog inputs shall be checked for being out of range (via high and low limit checks) and alarmed.

12. All process flow streams shall be labeled and color coded. All structures and equipment shall be identified by name and appropriate equipment and loop tags.

13. Color coding for equipment status and alarms shall be as follows:

    a. Green for on or open.

    b. Red for off or closed.

14. Automatically record all alarm and events should any of the following sequences or events occur:

    a. Date/Time entry

    b. Limit changes

    c. Any commanded or un-commanded change of any point

    d. Alarm conditions

    e. PLC activation or deactivation

    f. Operator login or logout activity

C. Specific Requirements:

1. Water overview screen shall include a site plan representation, indicating the geographic location of each process, and each building.

2. Main menu screen shall be developed to link to all screens and process areas. The screen shall be a complete and logical listing of the names and number of all screens

3. Overall plant process block flow diagram screen shall show all major processes in block form with flow arrows. Each block shall include a text description of key individual treatment processes. Navigational buttons to the individual treatment processes shall be performed by pressing on the text description.

4. Individual treatment process screens shall graphically screen key process variables and equipment. No operator entries shall be done from these screens. Individual process flow screens for each process shall include all process components, including tanks, pumps, blowers, mixers, drives, flow meters, valves, mechanical devices, as well as manual shutoff and isolation valves. These diagrams shall be generally depicted from the P&ID's and there shall be at least 1 screen per P&ID on average.

5. Individual unit process screens depicted from the P&IDs are used for control and screen of each major item of process equipment, process variables, and control devices, including pumps, blowers, valves, gates, mixers, drives etc. Navigational buttons shall consist of the P&ID's flow arrows to other individual unit processes. The unit process screens shall provide the ability for the operator to go to individual equipment popup screens. These diagrams shall be generally depicted from the P&ID's and there shall be at least 2 screens per P&ID on average.

6. Popup screens shall be provided for each piece of equipment to start/stop equipment, open/close valves, implement automatic control, adjust set points, establish, and adjust tuning parameters, set alarm limits, and initiate a sequence.

7. PLC system diagnostic screens, showing the operational status, and fault conditions of all PLC components, including processors, I/O modules, OIU's, power supplies and UPS units.

8. Communications diagnostic screens, showing the details of network status, communications status of all major components including Operator Workstations, peripheral devices, and network components.

9. Maintenance screens shall screen the raw value for each analog and digital I/O point in the system. They shall also allow the operators/maintenance personnel to enter an override value for an analog point that is then used by the system instead of the value read from the input card / communications link.

10. Trend screens with the capability to screen up to eight, operator assigned, analog and/or digital process variables. Each analog value will be shown on a trend screen.

11. Main alarm summary screen shall screen the following information on each alarm: Time, tag name, description, alarm type, current value, and status. An acknowledge alarm button shall acknowledge all new unacknowledged alarms. The acknowledged and unacknowledged alarms shall be different colors. Acknowledged alarms shall clear automatically after the condition is corrected.

12. Analog variable screens showing a tabular summary of all plant process variables, in operator assigned groupings.

D. Security:

1. The system shall be configured and implemented with security to prevent unauthorized access. The system shall allow authorized changes to system operation through defined user accounts and password verification.

2. Coordinate with Owner user account information, including login name and password for each account.

3. Security levels of "display only", "operator mode", "supervisor mode", and "engineer mode" shall be available through assignable passwords. On system startup, the "display only" security level shall automatically be entered. In the "display only" mode, information is available to be displayed on the screen, but no changes may be made. In the "operator mode", changes may be made to process set points, times, etc.; however, the overall control concepts may not be modified. In the "supervisor mode", all operator functions can be modified, and any special reports or critical process set points (data can be modified; however, the overall control concepts may

not be modified). In the "engineer mode" level, all user modifiable parameters of the system shall be available for modification.

E. Alarm/Equipment Status Reporting:

1. The alarm log shall display all alarms as they occur. The alarm message shall include the time of occurrence, tag name, tag number, and whether it is a low, high, or failure alarm. When the point in alarm returns to normal, the time, point identification number, and return to normal shall be displayed. All reports shall include the plant equipment number of the associated device.

2. The equipment's status shall be logged whenever a change in status occurs (i.e., start, stop). The equipment status log shall include the time, equipment name, tag number, and the change in status.

F. Historical Data Management:

1. Each system point (analog or digital, real or pseudo) shall have the capability of being historically logged. A point shall have the capability of being deleted from historical log at any time. It shall be easy to add or delete system points using minimal keystrokes.

2. All process analogs and all flow totals and run time indications of all primary process equipment motors shall be sampled and stored in the historical data management system.

3. Data Processing: The real time instantaneous values shall be stored in a historical log file on the hard disk at defined sampling rates.

4. Data Correction: Historical data shall be manually modifiable by personnel with appropriate security levels. Such data shall be differentiated from actual monitored values on reports, in the database and in trends.

5. Data Quality: Data Quality flags shall propagate to the next higher level of history based on user selectable percentage determining tolerance levels for averages and totals. If the percentage of suspect data exceeds the tolerance level, the suspect data flag propagates to the next higher level. Maximums and minimums shall be taken from good data.

6. Manual Input Data Handling: This data shall consist of additional values not obtainable by the system such as laboratory analysis for use in reports. All manually entered data shall be entered and stored in the appropriate engineering units. All data entered shall be displayed for confirmation on the display prior to incorporation into the database.

G. Intrusion Alarms:

1. When any door is opened triggering an intrusion alarm, the station control panel OIU displays a keypad graphic. Personnel will have 5 minutes to enter the correct 4-digit pin code. If the incorrect pin code is entered or 5 minutes passes without entering the correct pin code an alarm sequence is to be initiated.

a. Final requirements to be closely coordinated with the owner during the review meetings specified within.

3.03. START-UP SERVICE

A. The system integrator/supplier shall provide the services of a qualified service technician/engineer to perform the following service duties.

1. Provide a minimum of two (2) days' on-site services to provide installation instruction to the contractor on all aspects of equipment installation.

2. Provide a minimum of three (3) days of onsite startup services to provide final system calibration, programming, and testing after completion of equipment installations.

3. Provide a minimum of one (1) 4-hour session at the job site to provide instruction to facility personnel in the operation, proper maintenance, trouble shooting, and repair of the equipment. Contractor to demonstrate proper operation of system to owner.

4. Following system startup, contractor is to correct any deficiencies at no additional cost to the owner.

B. Following completion of the above services, the supplier shall provide an affidavit to the facility, certifying that the system is installed and operating in accordance with the contract documents.

END OF SECTION

SECTION 17400

FLOW METERS (MAGNETIC TYPE)

PART 1 GENERAL

1.01. SECTION INCLUDES

A. The Contractor shall furnish and install, ready to operate, the magnetic-type flow metering equipment, complete with flow transmitters and all necessary accessories, in compliance with the following specifications and as shown on the Contract Drawings.

1.02. GENERAL REQUIREMENTS

A. It is a requirement of this specification that the elements of the system be provided by a single supplier. This supplier shall have total responsibility for the equipment and services specified in this section, as well as all other Division 17 specifications.

B. For ease of identification, designations for the various components of the metering systems to be furnished and installed are given in the following table.

TABLE 17400-1
SCHEDULE OF MAGNETIC FLOW METERING EQUIPMENT

Nameplate Designation	Flow Transmitter/ Element Flow Designation	Size	Liner Material	Flow Range (gpm or mgd)
Union Hill Flowmeter	FIT/FE-1130	24-inch	PTFE, PFA, or Teflon	0 to 6,945 gpm
Tallman Flowmeter	FIT/FE-2130	24-inch	PTFE, PFA, or Teflon	0 to 6,945 gpm

1.03. REFERENCES

A. NEMA ICS 1 - General Standards for Industrial Control and Systems.

B. NEMA ICS 3 - Industrial Systems.

C. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

D. NFPA 70 - National Electrical Code.

E. ISO 9001.

F. National Institute of Science and Technology (NIST) - Calibration method.

1.04. SUBMITTALS

A. Shop Drawings - Submit under provisions of Sections 01300, Submittals, and 01640, Equipment-General.

1. Refer to Section 17000, Instrumentation, for shop drawing format and content.

B. Operation and Maintenance Manual - Submit under provisions of Sections 01300, Submittals, and 01640, Equipment-General.

1. Refer to Section 17000, Instrumentation, for operation and maintenance manual format and content.

2. NIST calibration certificates for each flow meter.

C. Project Record Documents - Submit under provisions of Sections 01300, Submittals, and 01640, Equipment-General.

1. Refer to Section 17000, Instrumentation, for project record documents format and content.

1.05. DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Section 01640, Equipment-General.

B. Accept products on site in factory containers unless system is completely integrated into a pre-manufactured panel that has been factory tested. Inspect for damage. Store products in clean, dry area; maintain temperature to NEMA ICS 1 requirements.

1.06. MANUFACTURER QUALIFICATIONS

A. Transmitter and flow tube shall be manufactured by, and at, an ISO 9001 company/facility.

1.07. WARRANTY

A. Provide a two-year warranty for flow meters covering the entire unit including the electronics and the flow tube.

1.08. COORDINATION

A. Coordinate flow tube mounting locations with the General Contractor. Provide the General Contractor with the spool piece according to their timeline for working on the respective segment of pipe.

B. Contractor is responsible to verify with the supplier that the appropriate ratings and options are provided for each application, taking into account area classification, flow, passing media, temperature, and vacuum limitations. Any such deviation from that which is specified shall be brought to the Engineers' attention during shop drawing submittals.

PART 2 PRODUCTS

2.01. MANUFACTURERS

A. The flow metering equipment manufacturer and model shall be the following or equal:

1. Where polyurethane or teflon liners are required by Table 17400-1:

a. Foxboro 9300A series (1/2 to 16-inch) flow tubes
Foxboro 9100A or 9200A (1 to 78-inch) flow tubes
Foxboro Model IMT-25 SDADB10M-A-B flow transmitters

b. Krohne Model Optiflex 2000 Series flow tubes
Krohne Model IFC 100 flow transmitters

c. Rosemount Model 8705 flow tubes
Rosemount Model 8732E flow transmitters

d. Endress & Hauser Promag Series 10 flow meters

2.02. EQUIPMENT DESIGN

A. Flow Elements

1. Flow elements shall be magnetic flow tubes, low frequency electromagnetic induction type and shall produce a 4-20 mA output linear to liquid flow rate.

2. The flow tubes shall have ANSI Class 150 flanged ends. Wafer-style flow tubes are not acceptable.

3. The flow tube housing shall be stainless steel or cast aluminum.

4. Flow tubes shall be lined as required by Table 17400-1.

5. Electrodes shall be conical-shaped (bullet nose) and shall be Type 316L stainless steel, Hastelloy C, or Zirconium. Substantiate compatibility with media monitored in the shop drawing submittal.

6. The flow tube housing shall be splash-proof and weather-resistant. It shall be capable of accidental submergence in up to 30 feet of water for up to 48 hours without damage to the electronics or interruption of the flow measurement.

7. Empty Pipe Detection - Flow tube shall measure the conductivity between the electrodes to monitor for an empty pipe condition. Upon detection of an empty pipe condition, the flow transmitter shall indicate the pipe is empty on the main transmitter display and drive the flow signal to zero.

B. Flow Transmitters - The electronics portion of the magnetic flow meters shall include both a magnet driver to power the magnet coils and a signal converter.

1. Signal converters shall be wall mounted, housed in a NEMA 4X enclosure.

2. Terminal strips for electrical connections shall be supplied. Housing shall not need to be opened to make adjustments.

3. Transmitter (Converter) Electronic Characteristics

a. The electronics shall be of the solid-state, feedback type and utilize integrated circuitry.

b. The input span of the signal converter shall be continuously adjustable between 0 to 1 and 0 to 31 fps and the range adjustment shall be direct reading.

c. Complete zero stability shall be an inherent characteristic of the meter system to eliminate the need to zero adjust the system with a full pipe at zero flow.

d. The converter shall not be affected by quadrature noise nor shall it require zero adjustment or special tools for startup.

e. Input and output signals shall be fully isolated.

f. The converter output shall be 4 to 20 mAdc into 800 ohms.

g. The electronics shall be designed for operation on 120 VAC ±10 percent, 60 Hz ±5 percent.

h. The converter shall also include:

1) Integral zero return based upon a user-adjustable percentage of flow meter span. Setpoint shall be adjustable 0 to 10 percent.

2) Direct adjustment of scaling factor in engineering units.

3) Integral calibration self-test feature to verify proper operation at the electronics.

4) Local direct reading indicator calibrated in gallons per minute or million gallons per day as directed by the Engineer. Flow totalizer with manual reset.

i. Each meter shall be hydraulically calibrated to the specified flow range in a NIST-certified facility.

C. Performance Requirements

1. The equipment furnished shall measure, indicate, and transmit flow rates to within ±0.5 percent of actual flow from a flow velocity of 1.0 to 31 fps. Refer to Table 17400-1 for flow ranges for each meter.

2. Accuracy shall not be affected by changes in percent solids or changes in fluid density, temperature, or viscosity. Accuracy shall not be affected by the presence of air bubbles to a greater extent than the fluid volume represented by such air bubbles.

3. Maximum power consumption for each flow element shall be 15 watts.

4. Equipment design specifications shall be considered as an integral part of the performance requirements.

2.03. ACCESSORIES

A. Nameplates - Refer to Section 17000, Instrumentation. Wording of nameplate shall be as specified in Table 17400-1.

B. Mounting Hardware - Provide stainless steel mounting hardware as necessary to mount equipment in locations as described in the Contract Documents.

C. Cabling - Provide power, and signal, cable and conduit to locate transmitters in locations listed in Table 17400-1 and the Contract Documents according to Section 17000, Instrumentation.

D. Lightning and Surge Protection - Provide lightning and surge protection for the equipment listed in Table 17400-1 in accordance with Section 17000, Instrumentation.

E. Flow tubes shall be provided with grounding rings on each flange. Grounding electrodes or straps are not an acceptable alternative. Materials of construction shall be Type 316L stainless steel, Hastelloy C, or Zirconium as chemically compatible with the measured media.

F. Spool Pieces - Provide one spool piece for each flow tube provided. Provide the General Contractor with the spool piece according to their timeline for working on the respective segment of pipe.

G. Portable secondary calibrator for checking calibration of the magnetic flow meters shall be provided. The unit shall have an adjustable setting to simulate signal output for a given flow velocity from 0 to 99.99 ft/sec. This unit is not required for flow meters with calibration checking integral to the transmitters.

PART 3 EXECUTION

3.01. INSTALLATION

A. Install all equipment furnished under this section in compliance with Section 01640, Equipment-General.

3.02. SERVICES OF MANUFACTURER'S REPRESENTATIVE

A. Installation - Include 1/2 day of a manufacturer-approved field technician's time to verify proper mounting of equipment.

B. Final Acceptance - Include 1/2 day of a manufacturer-approved field technician's time to test equipment to demonstrate that:

1. Flow metering systems have been properly installed, properly calibrated, and are functioning as specified.

2. Grounding rings are installed, grounded to the flow tube, and the flow tube grounded to the building's grounding grid or a proper ground in the termination control panel where the flow rate signal is wired. Grounding to the pipe is not acceptable.

3. Flow metering systems indicate the correct flow rate for three different rates of flow in the appropriate discharge line.

4. Integral zero return is configured to eliminate erroneous readings.

5. Calibrated span of the flow meter's 4-20 mA output is visible manufacturer's nameplate of the flow tube.

6. Configuration and setpoints are not lost upon power loss. This shall be tested by disconnecting the transmitter from power for 30 minutes.

7. Flow Totalizer Pulse – Configure the transmitter to generate a pulse every unit of gallons. Unit of gallons shall be configured such that a pulse is not generated any more frequently than every 2 seconds under maximum flow conditions.

C. Submit a written report to the Engineer and the system integrator with the results of field testing. In the report, include span and range for the 4-20 mA output signal.

D. Training - Provide 1/2 day of instruction for four persons to be conducted at the project site with a manufacturer's representative. Notify the Engineer and Owner in writing a minimum of two weeks in advance. Training shall include calibration, troubleshooting, and maintenance.

3.03. CERTIFICATION OF TESTING

A. Unless waived in writing by the Engineer, all tests shall be made in the presence of a duly authorized representative of the Owner. When the presence of such representative is so waived, certified results of the tests made and the results thereof shall be furnished by the Contractor.

B. All tests shall be performed in the presence of the Owner. Written notice of all tests shall be given the Owner at least two weeks in advance.

END OF SECTION

SECTION 17650

GAS DETECTION

PART 1 GENERAL

1.01. RELATED DOCUMENTS

A. Contract Drawings and general provisions of contract, including General and Supplementary Conditions, Division 1 and all of Division 16 Specifications, apply to this section.

1.02. SUBMITTALS

A. Submit all product and system data.

B. Submit shop drawings and product data for all equipment covered in this specification including:

1. Complete assembly, schematic, and installation drawings.

2. Descriptive information on materials and equipment furnished.

3. Complete drawings and wiring diagrams.

4. Complete product data

5. Performance data.

6. Furnish O&M Manuals.

7. Warranty information.

8. Point to point wiring diagrams

1.03. GENERAL REQUIREMENTS

A. It is a requirement of this specification that the elements of the system be provided by a single supplier. This supplier shall have total responsibility for the entire system performance and compatibility of this section.

B. For ease of identification, equipment tags for the various components of the gas monitoring system to be furnished are depicted on the Contract Drawing Riser Diagrams and Floor Plans.

1. Provide labeling for each device/control panel as called for and shown on the Contract Drawings.

C. Equipment to be UL listed.

1.04. SCOPE OF WORK

A. Provide and install a gas detection system complete with sensing devices, transmitter, displays, calibration equipment, alarm/horn stations, conduit & wire, control panel, sample pumps, tubing, and manufacturer's cable as follows and as shown/specified on the Contract Drawings. Typical of one (1) system as shown on the Contract Drawings.

1. Union Hill Pump Station (gas sampling system with remote alarm light/horn stacks).

B. Refer to Contract Drawing Riser Diagrams and Floor Plans for device quantities, equipment tags, and additional information.

C. Sensors shall monitor for combustible gas (LEL), hydrogen sulfide (H2S), oxygen depletion (O2), and carbon monoxide (CO). Control panel to include four (4) internal sensors.

1. Range of devices to be as follows:

a. LEL: 0-100% LEL

b. H2S: 0-50 PPM

c. O2: 0-25%

d. CO: 0-100 PPM

D. Provide as-built drawings upon completion of installation.

E. Provide two year full replacement warranty on all equipment as part of this specification section. Warranty shall replace, with new (not refurbished) equipment. Warranty duration shall commence on the date of substantial completion. Submit warranty information during submittal phase.

F. Provide commissioning services, startup services, and training services.

PART 2 PRODUCTS

2.01. MANUFACTURERS

A. The gas detection systems shall be the following or approved equal:

1. Mine Safety Appliance (MSA) MultiGard 5000 Gas Sampling System.

a. Provide as part # A-MG5000-D-B-D-B-B-B-A-AA-B-B.

b. Provide unit with sampling pumps, tubing, 4-sensors, etc. for a complete and operable gas monitoring system.

B. Note for reference, a distributor of the above equipment is as follows:

1. Applied Measurement & Control
   1246 Commercial Drive, B01
   Farmington, NY 14425
   Phone: 585-398-7260
   sales@appliedmc.com

2.02. EQUIPMENT DESIGN

A. Gas Sampling System

1. General - The monitoring system shall draw, via an internal pump, gas samples to the internal analyzer(s) from up to 32 locations and sequentially measure the gas concentration. The system shall provide visual alarm indication when preset levels are exceeded. Relay outputs for the purpose of external alarm or control shall be provided. Gas concentrations and alarm settings can be exported to a flash drive into a .CSV format.

2. The system shall consist of the following three sub-systems, all of which are to be mounted in a single enclosure:

   a. System Controller

   b. Gas Sample Handler

   c. Four Sensors (LEL, H2S, O2, CO)

3. Enclosure shall be NEMA 1 rated.

   a. Access Door - A full length front access door shall be provided.

   b. Electrical Entry - A gasketed, removable plates shall be provided in the enclosure bottom for purposes of providing electrical entry

   c. Sample Tubing Connection - NPT fittings suitable for the connection of ¼” OD, 3/16” inch ID tubing shall be provided on the sides of the enclosure for the purposes of connection, sample lines, calibration gases and exhaust.

   d. Indicators - An impact resistant 10" diagonally measured color TFT touchscreen Display for gas sample systems shall be provided on the access door of the enclosure for the purpose of viewing all operational parameters of the unit.

   e. Mounting - Brackets suitable for wall mounting shall be provided.

   f. Controls - There shall be no switches, levers or buttons on the front cover of the unit. The operator interface to the unit shall be via the soft buttons on the front panel display. These soft buttons are activated by touching the front panel display screen.

4. Controller

a. Type - The controller shall be an Allen-Bradley (AB) CompactLogix Logic Controller.

b. Programmable Functions - All programmable functions will be entered via the soft keys on the front panel touch screen. The following functions shall be programmable:

1) Sequencing point order

2) Manual calibration sequence

3) Automatic standardization, sequence and associated timing parameters and adjustment limits.

4) Parameters for the common alarm relays:

a) latching or non-latching alarm function

b) upscale or down scale acting alarms

c) fail safe or non-fail safe relay operation

d) On delay relay operation

e) Off delay relay operation

5) Removal or skipping of any location from the sampling sequence

6) Setting Trouble, Warning and Alarm trip point levels per sampling point per analyzer or sensor

7) Changing the password

8) Setting the gas sample transport time per sampling point

9) Setting the analysis time

10) Enabling the extended analysis time with the following trigger threshold parameters:

a) Rate of signal rise per analyzer or sensor

b) Signal level increasing to a preset level

c) Signal level decreasing to a preset level

11) Setting the alarming hysteresis per analyzer or sensor

12) Parameters for the optional user configured output relays:

a) fail safe or non-fail safe relay operation

b) On delay relay operation

c) Off delay relay operation

d) Steady or pulsed outputs

c. Programming Lock Out - A password shall be necessary for the purpose of preventing unauthorized personnel from altering the systems programmed parameters.

d. System Memory - All programmed values shall be stored on a Secure Digital (SD) Card that is local to the processor. Battery backup shall be provided to retain current status if power is lost.

e. Alarm/Control - Four common alarm/control set point levels shall be provided for all sample location. These four will be: Horn, Trouble, Warning and Alarm. Theses relays will be single pole double throw (SPDT) at least 8 amp @ 250 VAC. The system shall have the capability of providing up to 64 optional user configurable discrete alarm relays or solid state outputs.

1) Optional user configurable discrete alarm relays

a) These optional discrete alarm relays shall be single pole double throw (SPDT) at least 10 amp @ 250 VAC.

b) These optional discrete alarm relays shall be available in the following configuration:

- 16 warning and 16 alarm relays
- 32 warning and 32 alarm relays

2) Optional user configurable solid state outputs

a) These optional solid state outputs shall be capable of sinking 100 mA @ 24 VDC.

b) These optional solid state outputs shall be available in the following configuration:

- 16 warning and 16 alarm outputs
- 32 warning aned 32 alarm outputs

f. Front Panel Display

1) Alarm Indication

2) Location Indicator

3) Malfunction Indicator - The display shall be indicate any of the following conditions:

a) analyzer under range

b) analyzer over range

c) auto standardization limit exceeded

d) flow failure

4) Sequence Mode Indication

5) Calibration Mode Indication

g. Automatic Analyzer Correction - The controller must be capable of introducing zero and calibration gases and automatically correcting the gas value reading. Timing and limits setting shall be programmable

h. Data Storage – Gas concentrations and alarm setting shall be capable of being exported to a flash drive in .CSV format via a removable SD Card.

i. Digital Output – An optional; Modbus TCP or BACnet IP output shall be available to enable communication to other equipment or controllers.

5. Sample Handling

a. Sample Line Compatibility - The system shall be capable of drawing a gas sample through 3/16” ID NPT tubing for a distance of 166.6 meters (500 feet).

b. Sample Line Flow Rate - The system shall be capable of drawing a gas sample through 0.175" ID tubing at a rate of at least 20 SCFH (10 LPM) typical, no load. The full load rate shall be: 10 SCFH (5 LPM) typical.

c. Gas sampling scheme - The system shall employ a look ahead bypass sampling scheme. The system will not only pump on the current sampling point but also pump on the next sampling point even if the sampling point order is not in numeric order.

d. Sample Conditioning - The system shall provide adequate filtration of the sample suitable to protect the analyzer.

e. Exhaust - Exhaust fitting shall be provided on the side of the enclosure for the purpose of attaching exhaust lines to the sample and bypass flows.

f. Calibration Gas Connection - Inlet fittings shall be provided on the side of the enclosure for the purpose of connecting the calibration gas supplies (zero and span).

g. Flow Failure Detection - The system shall be capable of detecting a flow failure in any of the sampling lines

6. Analyzer - The analyzer sub-system shall detect dangerous presence of gas per manufacturer recommendations. Gas sensors to be internal to system. Sample tubing to be provided that samples air from potential hazardous spaces and analyzes local at the gas control panel.

7. System Performance

   a. Analyzer Reproducibility requirement - The analyzer(s) must keep its output signal reproducible within the limits of +2% Full Scale (FS).

   b. Analyzer Stability requirement - The 24 hour zero or span drift of the analyzer(s) must be less than 2% without the aid of automatic or manual recalibration.

   c. Environmental Specifications

      1) Operating: 32° to 95°F (0° to 35°C)

      2) Non-Operating: 14° to 140°F (-10° to 60°C)

      3) Gas Sample: 0° to 140°F (-17° to 60°C)

      4) 5 to 85% RH non-condensing (humidity)

8. Programming Limits

   a. Gas Sample Point Dwell Time = 10-300 seconds (in one second increments) per point.

   b. Alarm Levels = 0-100% of full scale in one percent increments

   c. Frequency of Automatic Zero = Every 8 hours

   d. Frequency of Automatic Span = Every 8 hours

   e. Automatic Adjustment Limits = "5% (before trouble is indicated)

9. System shall operate at 120VAC.

10. Max System Maintenance Requirement - With the exception of resupply of zero and span gas, no routine maintenance shall be required.

11. Gas monitoring panel shall include internal power supplies and relays as required to energize the alarm light and sounder circuits shown on the Contract Drawings.

B. Combustible Gas Monitors

1. Sensor to be ultima XIR or approved equal

2. 316 stainless steel enclosure shall satisfy Class I, Division 1, Groups A, B, C, and D hazardous atmospheres.

C. Toxics and Oxygen Gas Monitors

1. Toxic gas sensors shall be the electrochemical type. The sensor must not require the periodic addition of reagents.

2. Oxygen depletion sensors shall be the electrochemical fuel cell type. The sensor must not require the periodic addition of reagents.

3. Gas measurement shall be temperature compensated.

4. Shall be a remote diffusion type, resistant to silicone poisoning and hydrogen sulfide poisoning.

5. 316 stainless steel enclosure shall satisfy Class I, Division 1, Groups A, B, C, and D hazardous atmospheres.

6. Each sensor shall have its own input output amplifier section.

D. All Gas Monitors

1. Each transmitter shall produce a directly proportional 4-20 mA output correlating to 0 value at 4 mA and 100 percent full value at 20 mA.

2. 316 stainless steel enclosure with UL approved NPT conduit entries.

3. Calibrations shall be performed without opening the transmitter enclosure.

4. Transmitters to be powered from the gas monitoring control panel. Provide all necessary control panel internal power supplies in order to provide power to sensors/transmitters.

5. Performance Requirements

a. Repeatability - Less than 2 percent full-scale for 0 to 100 percent LEL.

b. Operating Temperature - -4 to 122 degrees F.

c. Operating Humidity - 0 to 95 percent non-condensing.

d. Stability - +3 percent full-scale per year.

e. Linearity - Less than +2 percent full-scale.

f. Response Time - Less than 30 seconds.

g. Operating Voltage - 24 VDC, 3-wire.

1) Transmitters to be powered out of proposed gas monitoring panel. Provide necessary DC power supplies, control transformers, etc. as required to provide an overall complete/operable system.

2.03. WIRING

A. All circuitry (conduit & conductors) as shown/specified on the Contract Drawings shall be included for an overall complete and operable system. Refer to Riser Diagrams on Contract Drawings for circuitry specifications.

2.04. ACCESSORIES

A. Nameplates - Provide rigid, laminated name tags with 5/16-inch high white letters on black background. Each monitor shall have nametags for the monitor designation and the designations for each of the sensors it monitors. Each alarm light shall have a nameplate indicating its intent.

B. Provide calibration kit per manufacturers recommendations.

C. Provide end of line (EOL) filter kit per manufacturer recommendations.

D. Provide teflon tubing (1/4" OD & 3/16" ID) as indicated on the contract drawings. Provide all necessary installation hardware and brackets for installation.

2.05. CONTROLS

A. All equipment specified in this section shall be electrically complete in that the Contractor is required to furnish and install only exterior power and signal wiring, conduits, fittings, etc. Labeled terminal strips shall be utilized throughout.

B. Contractor shall furnish sufficient length cables as required by the equipment manufacturer. Cables shall be installed in conduit by the Contractor.

C. Where required, alarm and warning setpoint gas concentrations shall be as follows and configured as such for the respective transmitters:

1. Combustible Gas - Warning 10.0 percent LEL; alarm 20.0 percent LEL.

2. Hydrogen Sulfide - Warning 10.0 ppm, alarm 15.0 ppm.

3. Oxygen Depletion - Warning 19.5 percent, alarm 18.0 percent.

4. Carbon Monoxide - Warning 10.0 ppm, alarm 15.0 ppm.

PART 3 EXECUTION

3.01. INSTALLATION

A. Installation shall be in strict accordance with the respective instructions of the manufacturers in the locations shown on the Contract Drawings.

3.02. FIELD SERVICE

A. Calibrate sensors

B. Configure warning setpoints

C. Configure alarm setpoints

D. Configure the Transmitter to drive the analog output signal to 3.7 mA in the event of failed self-diagnostic tests.

E. Programming - Include 1 day for a manufacturer authorized service representative to meet on-site with the owner/engineer to discuss sequence of operation.

1. i.e, which lights/horns are to illuminate and when, etc..

F. Final Acceptance - Include 1/2 day for a manufacturer authorized service representative to test equipment to demonstrate that the system operates as specified.

G. Installation - Include 1 full day for a manufacturer authorized service representative to verify proper mounting of the equipment, including mounting technique, mounting surface, and functional location.

1. Provide MSA model # Z-COM-PREM-4 premium factory on-site commissioning services at each project site (typical of 4 locations).

H. Training - Provide a two-hour session of instruction to be conducted at each project site by the manufacturer (typical of 4 training sessions). Notify the Engineer and Owner in writing a minimum of two weeks in advance. Duration of training is actual on-site training time with the operators; travel and other time shall be separate from this training requirement.

END OF SECTION